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SEVENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1889.

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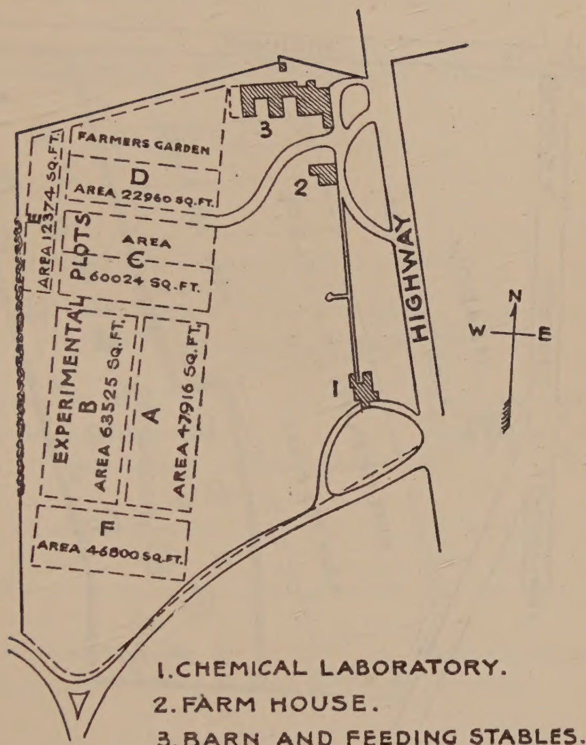
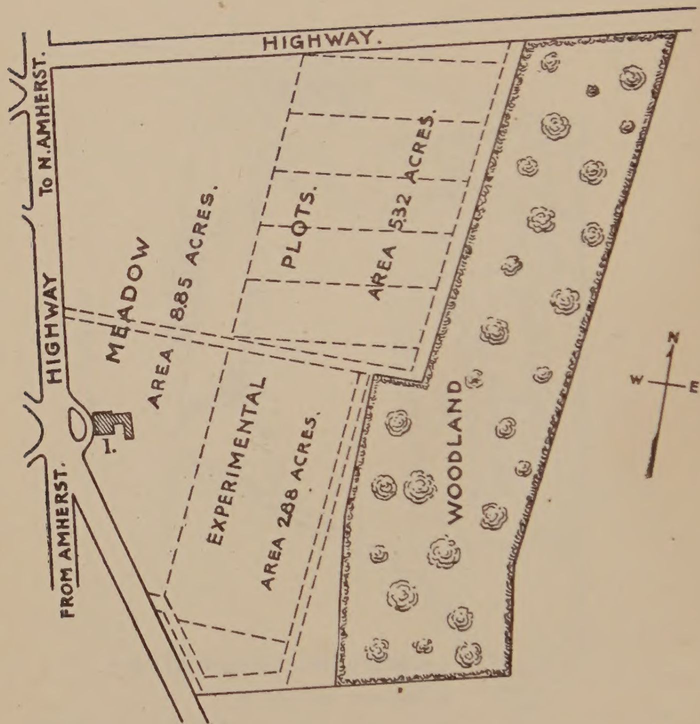


·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·WEST·OF·THE·HIGHWAY·
·AREA·TAKEN··17.72·ACRES·



1. AGRICULTURAL AND PHYSIOLOGICAL LABORATORY.

·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
AGRICULTURAL·COLLEGE·FARM·
·EAST·OF·THE·HIGHWAY·
AREA·TAKEN· 30.52 ACRES·

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

OFFICERS APPOINTED BY THE BOARD OF CONTROL.

Hon. W. R. Sessions,	*Secretary and Auditor of the Board*, .	Hampden.
Dr. J. P. Lynde,	*Treasurer of the Board*, ...	Athol.
C. A. Goessmann, Ph.D., LL.D.,	*Director and Chemist*, .	Amherst.
J. E. Humphrey, S.B.,	*Vegetable Physiologist*, . . .	Amherst.

ASSISTANTS.

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E. R. Flint, B.S , . . .	. " " "
R. B. Moore, B.S., . .	. " " "
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B. L. Hartwell, B.S., .	. " " "
W. A. Parsons, B.S., .	. *Field Experiments and Stock Feeding.*
David Wentzell, . .	. *Farmer.*

BOSTON, Jan. 14, 1890.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882, I have the honor to present the Seventh Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

SEVENTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN : — The past year has been a prosperous one. The State Legislature has granted your application for the appropriation of means to erect suitable buildings required for much-needed investigations into some special features of plant growth and of diseases of agricultural plants. The plans adopted for the construction of an agricultural and physiological laboratory have been successfully carried out, and the building will be shortly ready for occupation. The expenses incurred in carrying on this work are fairly within the sum assigned for that purpose.

No serious loss of any description has happened to the property of the State. The various structures of the station are in a well-preserved condition, and the live stock for experimental purposes is at present more complete as far as the different kinds of farm live stock are concerned than at any previous period.

The experimental work of the year has been, as far as practicable, in conformity with the plans from time to time presented for your endorsement. No material changes have been made in regard to the principal lines of investigations decided upon during the preceding years. The work in the field, in the barn and in the laboratory, has received, as far as practicable, an equal share of attention.

Professor Humphrey has devoted much attention to various subjects in his special line of investigation. A detailed description of his work on fungoidal diseases, etc., prepared by him, forms a part of the accompanying annual report.

The experiments to determine the cost of feed for the

production of milk and of pork have been continued, with some modifications; to these have been added of late experiments to ascertain the cost of feed for the production of beef and mutton. A variety of field crops, in particular reputed fodder crops, have been raised for testing their relative feeding value, and to determine their general merits in a mixed farm management. Some of these crops suffered, in common with our grain crops, from exceptionally cool and wet weather during the latter part of June and the months of July and August.

The laboratory work has been exceptionally large and in various directions, in consequence of the additional chemical work called for by the Hatch Experiment Station, and by the State inspection of commercial fertilizers; aside from the numerous applications of farmers, associations, and parties interested in farming, for the examination of fertilizers, fodder articles, well-waters, etc.

The details of the work carried on in the previously stated directions are recorded in the subsequent pages under the following headings: —

Feeding Experiments.

I. Feeding experiments with milch cows, to ascertain the feeding value of fodder corn, corn stover and corn ensilage, as compared with English hay, and also of sugar beets and of carrots.

II. Feeding experiments with milch cows, to ascertain the value of a mixed crop of vetch and oats, of Southern cow-pea and of serradella, when fed as green fodder in part or in the whole for English hay.

III. Financial record of twelve cows, kept at the Massachusetts Experiment Station.

IV. Creamery record of the station during the years 1887, 1888 and 1889; with some observations made during several visits to the farms of one hundred and ninety-three patrons of two creameries in our vicinity.

V. Feeding experiments with pigs; skim milk, barley meal, corn meal, wheat bran and gluten meal serving as fodder ingredients of the daily diet.

Field Experiments.

VI. Experiments to compare the effect of different forms of nitrogen on the growth, etc., of corn.

VII. Influence of fertilizers on the quantity and quality of fodder crops.

VIII. Experiments with field and garden crops.

IX. Experiments with green crops for summer feed.

X. Professor Humphrey's report: —

1. General account of fungi.
2. Potato scab.
3. Diseases on station farm.
4. Observations of material sent on for examination.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

XI. Analyses of licensed commercial fertilizers.

XII. Miscellaneous analyses of material sent on.

XIII. Water analyses.

XIV. Compilation of fodder analyses, with reference to fodder constituents and fertilizing constituents; analyses of industrial products, garden crops, fruits, etc., made at Amherst, Mass.

XV. Meteorological observations.

The periodical publications of the station have been more numerous than in preceding years, on account of the monthly publications of the analyses of licensed fertilizers required by the new laws for the regulation of the trade of commercial fertilizers. Four bulletins, containing reports of progress on investigations, and six monthly circulars of fertilizer analyses, have been issued. The interest in the publications of the station is steadily growing. From ten to eleven thousand copies have been published of late.

It gives me particular pleasure to acknowledge the valuable assistance rendered by all parties engaged in the work of the station. To their marked industry and faithful execution of the various tasks assigned to them is largely due the successful termination of the work recorded in this report.

Thanking you sincerely for your kind indulgence in the performance of my duties, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 14, 1890.

ON FEEDING EXPERIMENTS.

I. Feeding experiments with milch cows, to determine the value of fodder corn, corn stover and corn ensilage, as compared with English hay; and also of corn ensilage, as compared with that of sugar beets and carrots. The statement closes with a summary of observations in that connection during four successive years, 1885 to 1889.

II. Feeding experiments with milch cows, to ascertain the value of vetch and oats, of cow-pea and of serradella when fed as green fodder in part or in the whole for English hay. The results reported are those of the third year of our trial.

III. Record of twelve cows kept at the Massachusetts Experiment Station.

IV. Creamery record of the station during the years 1887, 1888 and 1889; and some observations made during visits to the patrons of two creameries in our vicinity.

V. Feeding experiments with pigs; skim-milk, barley meal, corn meal, wheat bran and gluten meal serving as fodder ingredients of the daily diet.

VI. Fodder analyses.

I. Record of Feeding Experiments with Milch Cows, to determine the Relative Value of Fodder Corn, Corn Stover and Corn Ensilage, as compared with that of English Hay; and of Corn Ensilage as compared with that of Sugar Beets and of Carrots, under Otherwise Corresponding Circumstances. Fourth Year of Observation, from November, 1888, to May, 1889.

The experiment was conducted upon the same general plan as during the preceding years, the principal object of the investigation remaining the same as stated above. A

larger number of cows (nine) than in any of the preceding years took part in the trial; not more, however, than six cows at any one time. Whenever the daily yield of milk of any particular animal fell below from six to seven quarts, on account of advanced milking period, a new-milch cow was substituted, to secure, as far as practicable, corresponding conditions throughout the entire experiment. Grades of various descriptions, yet of a similar quality with regard to the production of quantity and quality of milk, constituted our herd. They varied in age from five to eleven years; the mean in case of nine cows was seven years. Each served from two to seven months for our observation.

The course adopted in preparing the daily diet was essentially the same as in the preceding year. English hay, fodder corn, corn stover, corn ensilage, sugar beets and carrots served as coarse fodder articles; and corn meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous to non-nitrogenous substances in the daily fodder rations (commonly called nutritive ratio). The fodder corn, corn stover and corn ensilage were cut to an even length (one and one-half to two inches) before fed. The daily amount of fodder corn left behind unconsumed was, on an average, two and one-half pounds, and that of corn stover and ensilage about three pounds.

The same variety of corn, Pride of the North, a dent corn, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same variety and the same state of maturity as the one which furnished the dry fodder corn; *i. e.*, at the beginning of the glazing over of the kernels.

The experiment was subdivided into nine feeding periods, extending over a period of seven months. The same quantity of corn meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily, from the beginning to the close of the trial. Corn ensilage and roots were fed in different proportions, with one-half or one-fourth of a full English hay ration. Fodder corn and corn stover were fed most of the time by themselves.

The quantity of different fodder rations stated below

represents in each case the daily average of the amount actually consumed per head during the entire feeding period. The variations in the daily consumption of the various ingredients of the daily diet in case of different animals were confined entirely to the fodder corn, the corn stover and the corn ensilage, when serving as substitutes in part or in the whole for hay; and to hay, when fed alone as the coarse or bulky part of the daily diet. The amount consumed in that case was controlled by the appetite of the animal, as somewhat larger quantities than the figures represent were offered for their consumption. The daily consumption of the grain feed was limited to the amount stated in each case; the same statement applies to the hay when fed in connection with some other coarse fodder articles, as corn ensilage, sugar beets, etc.

The nutritive ratio of the different diets used varied from 1 : 5.13 to 1 : 6.79. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

The temporary changes in diet, whenever decided upon, were carried out gradually, as is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates, which accompany all detailed reports in our feeding experiments, past and present, furnish exact figures in that direction. This is in particular the case whenever such statements are of a special interest, for an intelligent appreciation of the final conclusions presented.

The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of fodder ingredients is based, in this connection, on the local market price per ton of each article for the period of observation.

Corn meal,	$21 90	Fodder corn,	$5 00
Wheat bran,	20 70	Corn stover,	5 00
Gluten meal,	23 40	Corn ensilage,	2 75
Hay,	15 00	Carrots,	7 00
Rowen,	15 00	Sugar beets,	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4½ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management; while twenty per cent. is assumed to be sold with the milk, and thus lost to the farm.

The obtainable manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed. In some instances it amounts to more than one-half of the original cost of the feed consumed.

Net cost of feed represents the sum obtained by subtracting eighty per cent. of the commercial value of the fertilizing constituents contained in the fodder consumed, from the total cost of the feed. Nothing but the net cost of feed is considered in the discussion of the cost of production of milk and of cream.

An examination of the subsequent detailed description of the experiment under consideration leads to the same conclusions as our observations in this direction during preceding years: —

1. The high nutritive value of fodder corn, corn stover and good corn ensilage, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animal on trial, as well as the quality and the quantity of the milk obtained, point in that direction.

2. To produce one quart of milk, using the same quantity and quality of grain feed, required in every instance a larger quantity of perfectly dried hay than of either fodder

corn, corn stover or corn ensilage in a corresponding state of dryness, — corn stover leading.

3. The net cost of feed in the case of the same ration of grain feed is from one-third to one-half less per quart of milk, when fodder corn, corn stover or corn ensilage serve as substitutes for English hay in the daily diet of milch cows; corn fodder, as a rule, leading, while corn stover leads the corn ensilage in four out of six cases.

4. Sugar beets, as well as carrots, when fed pound for pound of dry matter in place of part of the hay ration, with the same kind and quantity of grain feed, have raised almost without an exception the temporary yield of milk; exceeding, as á rule, the corn ensilage in that direction.

5. Corn ensilage, as well as roots, proved best when fed in place of one-fourth to one-half of the full hay ration. From twenty-five to twenty-seven pounds of roots, or from thirty-five to forty pounds of corn ensilage, per day, with all the hay called for to satisfy the animal in either case, seems for various reasons a good proportion, allowing the stated kind and quantity of grain feed.

6. The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet. The increase in the quantity of milk is frequently accompanied by a decrease in solids.

Quarts of Milk required to make One Space of Cream. (Average of Six Cows fed upon the Following Rations.)

Hay Period.	Fodder Corn Period.	Corn Stover Period.	Carrot Period.	Corn Ensilage Period.	Sugar Beet Period.
1.98	1.68	1.59	2.16	1.92	1.88

For further details, consult the subsequent record of our experiment (November, 1888, to May, 1889), and also the summary of our investigations during 1885, 1886, 1887, 1888 and 1889, in connection with the subject under discussion.

FEEDING RECORD.

ANNIE: *Age, six years; grade, Jersey; last calf, June 19, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Nov. 1 to Nov. 15,	3.25	3.25	3.25	18.67	–	–	–	–	–	–	25.84	10.68	2.42	1 : 6.14	830
Nov. 20 to Dec. 11,	3.25	3.25	3.25	–	13.27	–	–	–	–	–	17.05	8.51	2.00	1 : 5.44	784
Dec. 17 to Dec. 27,	3.25	3.25	3.25	–	–	14.36	–	–	–	–	15.83	7.09	2.23	1 : 5.66	766
Jan. 3 to Jan. 21,	3.25	3.25	3.25	10.00	–	–	37.05	–	–	–	21.55	10.27	2.10	1 : 6.16	808
Jan. 29 to Feb. 19,	3.25	3.25	3.25	5 00	–	–	–	29.91	–	–	20.88	10.10	2.07	1 : 6.34	806
March 1 to March 14,	3.25	3.25	3.25	15.00	–	–	–	–	–	–	22.46	9.07	2.48	1 : 5.90	842
March 19 to April 2,	3.25	3.25	3.25	10.00	–	–	–	–	43.53	–	23.43	10.28	2.28	1 : 6.12	847
April 9 to April 22,	3.25	3.25	3.25	16 50	–	–	–	–	–	–	23.84	10.20	2.34	1 : 6.00	880
April 30 to May 21,	3.25	3.25	3.25	–	–	–	–	–	–	16.64	23.49	10.42	2.25	1 : 5.13	888

MAY: *Age, eight years; grade, Jersey; last calf, June 6, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15,	3.25	3.25	3.25	20.00	–	–	–	–	–	–	27.06	10.13	2.67	1 : 6.22	950
Nov. 20 to Dec. 11,	3.25	3.25	3.25	–	17.68	–	–	–	–	–	19.84	8.05	2.46	1 : 5.71	907
Dec. 17 to Dec. 27,	3.25	3.25	3.25	–	–	21.82	–	–	–	–	19 55	8 43	2 32	1 : 6.19	902
Jan. 3 to Jan. 21,	3.25	3.25	3.25	10.00	–	–	39.37	–	–	–	21.78	9.53	2.29	1 : 6.20	892
Jan. 29 to Feb. 19,	3.25	3.25	3 25	5.00	–	–	–	38.86	–	–	23.15	9.13	2.54	1 : 6.66	937
March 19 to April 2,	3.25	3.25	3.25	10.00	–	–	–	–	43.33	–	23.41	9.64	2.43	1 : 6.11	930
April 9 to April 22,	3.25	3.25	3 25	16.93	–	–	–	–	–	–	24.24	9.29	2.61	1 : 6.03	976
April 30 to May 21,	3.25	3.25	3.25	–	–	–	–	–	–	18.05	24.74	10.01	2.47	1 : 5.18	962

FEEDING RECORD — *Continued.*

EVA: *Age, nine years; grade, Jersey; last calf, Oct. 7, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1888 and 1889.															
Nov. 1 to Nov. 15,	3.25	3.25	3.25	20.00	–	–	–	–	–	–	27.06	14.95	1.81	1 : 6.22	1,018
Nov. 20 to Dec. 11,	3.25	3.25	3.25	–	18.23	–	–	–	–	–	20.18	11.76	1.72	1 : 5.70	972
Dec. 17 to Dec. 27,	3.25	3.25	3.25	–	–	19.00	–	–	–	–	18.15	10.84	1.67	1 : 6.00	941
Jan. 3 to Jan. 21,	3.25	3.25	3.25	10.00	–	–	39.35	–	–	–	21.78	12.13	1.80	1 : 6.20	964
Jan. 29 to Feb. 19,	3.25	3.25	3.25	5.00	–	–	–	43.00	–	–	24.21	11.58	2.09	1 : 6.79	980
March 1 to March 14,	3.23	3.25	3.25	20.43	–	–	–	–	–	–	27.45	10.73	2.49	1 : 6.25	1,025
March 19 to April 2,	3.25	3.25	3.25	10.00	–	–	–	–	46.20	–	23.77	10.99	2.16	1 : 6.14	992

MELIA: *Age, eleven years; grade, Dutch; last calf, Aug. 5, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15,	3.25	3.25	3.25	18.73	–	–	–	–	–	–	25.89	9.60	2.70	1 : 6.15	1,063
Nov. 20 to Dec. 11,	3.25	3.25	3.25	–	13.45	–	–	–	–	–	17.16	7.17	2.39	1 : 5.45	1,025
Dec. 17 to Dec. 27,	3.25	3.25	3.25	–	–	17.18	–	–	–	–	17.24	6.48	2.66	1 : 5.87	1,027
Jan. 3 to Jan. 21,	3.25	3.25	3.25	10.00	–	–	39.37	–	–	–	21.78	7.66	2.84	1 : 6.20	1,062
Jan. 29 to Feb. 19,	3.25	3.25	3.25	5.00	–	–	–	31.32	–	–	22.00	7.20	3.05	1 : 6.50	1,094

FEEDING RECORD — *Continued.*

DAISY: *Age, six years; grade, Durham; last calf, Jan. 5, 1888.*

Feeding Periods.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	22.00	–	–	–	–	–	–	28.90	9.87	2.93	1 : 6.34	1,164
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	19.59	–	–	–	–	–	21.04	6.35	3.31	1 : 5.81	1,168
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	26.36	–	–	–	–	21.82	5.43	4.02	1 : 6.44	1,170
Jan. 3 to Jan. 18, .	3.25	3.25	3.25	10.00	–	–	43.25	–	–	–	22.17	6.09	3.64	1 : 6.26	1,195

MINNIE: *Age, nine years; grade, Ayrshire; last calf, May 3, 1887.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Dry Matter (Pounds).	Quarts of Milk per Day.	Dry Matter per Quart.	Nutritive Ratio.	Average Weight.
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	17.52	–	–	–	–	–	–	24.78	7.83	3.16	1 : 6.07	1,051
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	11.68	–	–	–	–	–	16.05	6.15	2.61	1 : 5.33	1,016

FLORA: *Age, five years; grade, Durham; last calf, Dec. 22, 1888.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Dry Matter (Pounds).	Quarts of Milk per Day.	Dry Matter per Quart.	Nutritive Ratio.	Average Weight.
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.05	–	–	–	21.75	15.30	1.42	1 : 6.20	900
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	30.91	–	–	21.13	13.31	1.59	1 : 6.38	862
March 1 to March 14, .	3.25	3.25	3.25	14.86	–	–	–	–	–	–	22.33	12.05	1.85	1 : 5.39	877
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.47	–	23.43	13.10	1.79	1 : 6.11	873
April 9 to April 22, .	3.25	3.25	3.25	18.21	–	–	–	–	–	–	25.41	13.02	1.95	1 : 6.12	917
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	19.23	25.80	13.37	1.93	1 : 5.21	918

FEEDING RECORD — *Concluded.*

JESSIE: *Age, five years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	42.09	–	–	23 98	14.12	1.70	1 : 6.76	735
March 1 to March 14, .	3.25	3.25	3 25	15.21	–	–	–	–	–	–	22.66	11.46	1.98	1 : 5.96	736
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	47.47	–	23.94	11.73	2.04	1 : 6.16	734
April 9 to April 22, .	3.25	3.25	3.25	18.93	–	–	–	–	–	–	25.08	12.78	1.96	1 : 6.16	794
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	20.27	26.72	13.23	2.02	1 : 5.24	800

ELSIE: *Age, six years; grade, Dutch; last calf, Feb. 26, 1889.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
March 19 to April 2, .	3.25	3.25	3 25	10.00	–	–	–	–	49.60	–	21.21	13.64	1.78	1 : 6.18	1,112
April 9 to April 22, .	3.25	3.25	3.25	21.32	–	–	–	–	–	–	28.27	12.25	2.31	1 : 6.30	1,115
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	23.45	29.55	12.33	2.39	1 : 5.31	1,128

Total Cost of Feed per Quart of Milk.

Annie.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, . .	160.25	10.68	48.75	48 75	48.75	280.00	–	–	–	–	–	–	$3 71	2.32
Nov. 20 to Dec. 11, .	187.25	8.51	71.50	71.50	71.50	–	302.00	–	–	–	–	–	3 11	1.66
Dec. 17 to Dec. 27, .	78.00	7.09	35.75	35.75	35.75	–	–	158 00	–	–	–	–	1 58	2.02
Jan. 3 to Jan. 21, .	195.25	10.27	61.75	61.75	61.75	190.00	–	–	704.00	–	–	–	5 93	3.04
Jan. 29 to Feb. 19, .	222.25	10.10	71.50	71.50	71.50	110.00	–	–	–	659.00	–	–	4 09	1.84
March 1 to March 14, .	127.00	9.07	45.50	45.50	45.50	210.00	–	–	–	–	–	–	3 08	2 43
March 19 to April 2, .	154.13	10.28	48.75	48 75	48.75	150.00	–	–	–	–	653.00	–	4 37	2.84
April 9 to April 22, .	142.75	10.20	45.50	45.50	45.50	231.00	–	–	–	–	–	–	3 23	2 26
April 30 to May 21, .	229.25	10.42	71.50	71.50	71.50	–	–	–	–	–	–	366 00	5 10	2.22

May.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	152.00	10.13	48.75	48.75	48.75	300.00	–	–	–	–	–	–	$3 86	2.54
Nov. 20 to Dec. 11, .	177.00	8.05	71.50	71 50	71.50	–	389.00	–	–	–	–	–	3 33	1.88
Dec. 17 to Dec 27, .	92 75	8.43	35.75	35.75	35.75	–	–	240.00	–	–	–	–	1 78	1.92
Jan. 3 to Jan. 21, .	181.00	9.53	61 75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	3.36
Jan. 29 to Feb. 19, .	200.75	9.13	71.50	71.50	71.50	110.00	–	–	–	855.00	–	–	4 36	2.17
March 19 to April 2, .	144.63	9.64	48.75	48.75	48.75	150.00	–	–	–	–	650.00	–	4 36	3.01
April 9 to April 22, .	130.13	9.29	45.50	45 50	45.50	237.00	–	–	–	–	–	–	3 28	2 52
April 30 to May 21, .	220.25	10.01	71.50	71.50	71 50	–	–	–	–	–	–	397.00	5 34	2.42

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Eva.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	224 25	14.95	48.75	48.75	48 75	300.00	–	–	–	–	–	–	$3 86	1.72
Nov. 20 to Dec. 11, .	258 75	11.76	71.50	71.50	71 50	–	401.00	–	–	–	–	–	3 36	1 30
Dec. 17 to Dec. 27, .	119.25	10.84	35.75	35.75	35.75	–	–	209.00	–	–	–	–	1 70	1.43
Jan. 3 to Jan. 21, .	230 50	12.13	61.75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	2.64
Jan. 29 to Feb. 19. .	254.75	11.58	71.50	71.50	71.50	110.00	–	–	–	946.00	–	–	4 49	1.76
March 1 to March 14, .	150.25	10 73	45.50	45 50	45.50	286.00	–	–	–	–	–	–	3 65	2.43
March 19 to April 2, .	164.88	10.99	48.75	48 75	48.75	150.00	–	–	–	–	693.00	–	4 47	2 71

Melia.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	144 00	9.60	48.75	48.75	48.75	281.00	–	–	–	–	–	–	$3 76	2.58
Nov. 20 to Dec. 11, .	157.75	7.17	71.50	71.50	71.50	–	296.00	–	–	–	–	–	3 10	1.97
Dec. 17 to Dec. 27, .	71.25	6.48	35 75	35.75	35 75	–	–	189.00	–	–	–	–	1 65	2.32
Jan. 3 to Jan. 21, .	145.50	7.66	61.75	61.75	61.75	190 00	–	–	748.00	–	–	–	6 08	4.18
Jan. 29 to Feb. 19, .	158.50	7.20	71.50	71.50	71.50	110.00	–	–	–	755.00	–	–	4 22	2 66

Total Cost of Feed per Quart of Milk — *Continued.*

Daisy.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	148.00	9.87	48.75	48.75	48.75	330.00	–	–	–	–	–	–	$4 08	2 76
Nov. 20 to Dec. 11, .	139.75	6.35	71.50	71.50	71.50	–	431.00	–	–	–	–	–	3 44	2.46
Dec. 17 to Dec. 27, .	59.75	5 43	35.75	35.75	35.75	–	–	290.00	–	–	–	–	1 90	3.18
Jan. 3 to Jan. 18, .	97.50	6.09	52.00	52.00	52.00	160.00	–	–	692.00	–	–	–	5 34	5.48

Minnie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	117.50	7.83	48.75	48.75	48.75	262.75	–	–	–	–	–	–	$3 58	3.05
Nov. 20 to Dec. 11, .	135.25	6.15	71.50	71.50	71.50	–	257.00	–	–	–	–	–	3 00	2.22

Total Cost of Feed per Quart of Milk — *Continued.*

Flora.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 3 to Jan. 21, .	290.75	15.30	61.75	61.75	61.75	190.00	–	–	742.00	–	–	–	$6 06	2.08
Jan. 29 to Feb. 19, .	292.75	13.31	71.50	71.50	71.50	110.00	–	–	–	680.00	–	–	4 12	1.41
March 1 to March 14, .	168.63	12.05	45.50	45.50	45.50	208.00	–	–	–	–	–	–	3 06	1.81
March 19 to April 2, .	196.50	13.10	48.75	48.75	48.75	150.00	–	–	–	–	653.00	–	4 37	2.22
April 9 to April 22, .	182 25	13 02	45.50	45.50	45.50	255.00	–	–	–	–	–	–	3 41	1.87
April 30 to May 21, .	294.13	13.37	71.50	71.50	71.50	–	–	–	–	–	–	423 00	5 53	1 88

Jessie.

Feeding Periods.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Jan. 29 to Feb. 19, .	310.75	14.12	71.50	71.50	71.50	110.00	–	–	–	926 00	–	–	$4 46	1.43
March 1 to March 14, .	160.50	11.46	45.50	45.50	45.50	213.00	–	–	–	–	–	–	3 10	1.93
March 19 to April 2, .	176.00	11.73	48.75	48.75	48.75	150.00	–	–	–	–	712.00	–	4 51	2 56
April 9 to April 22, .	178.88	12.78	45.50	45 50	45.50	265.00	–	–	–	–	–	–	3 49	1.95
April 30 to May 21, .	291.12	13.23	71.50	71.50	71.50	–	–	–	–	–	–	446.00	5 70	1.96

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Elsie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
March 19 to April 2, .	204.63	13 64	48 75	48.75	48.75	150.00	–	–	–	–	744.00	–	$4 59	2.24
April 9 to April 22, .	171.50	12.25	45.50	45.50	45.50	298.50	–	–	–	–	–	–	3 74	2.18
April 30 to May 21, .	272.25	12.33	71.50	71.50	71.50	–	–	–	–	–	–	516.00	6 23	2.29

Valuation of Essential Fertilizing Constitutents contained in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents. (1889.)
[Per cent.]

	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.
Moisture, . .	12.890	10.080	10.220	8.060	36.850	50.130	90.050	74.700	87.210	19.970
Nitrogen, . .	1.550	2.556	4.330	1.480	.992	.638	.127	.331	.208	2.030
Phosphoric acid,	.713	2.900	.392	.112	.367	.133	.100	.138	.086	.351
Potassium oxide,	.430	1.637	.049	.457	.801	.976	.070	.301	.462	2.794
Valuation per 2,000 pounds,	$6 51	$13 64	$15 23	$5 58	$4 53	$3 21	$0 62	$1 56	$1 23	$9 83

Net Cost of Milk and Manurial Value of Feed.

Annie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 71	$1 64	$1 31	$2 40	1.50	825
Nov. 20 to Dec. 11, .	3 11	1 95	1 56	1 55	0.83	790
Dec. 17 to Dec. 27, .	1 58	89	71	87	1.12	772
Jan. 3 to Jan. 21, .	5 93	1 84	1 47	4 46	2 28	812
Jan. 29 to Feb. 19, .	4 09	2 09	1 67	2 42	1.09	812
Mar. 1 to Mar. 14, .	3 08	1 39	1 11	1 97	1 55	845
Mar. 19 to Apr. 2, .	4 37	1 68	1 34	3 03	1.96	859
Apr. 9 to Apr. 22, .	3 23	1 45	1 16	2 07	1.45	895
Apr. 30 to May 21, .	5 10	3 07	2 46	2 64	1.15	890
Total, . .	$34 20	$16 00	$12 79	$21 41	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Continued.*

May.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 86	$1 70	$1 36	$2 50	1.64	950
Nov. 20 to Dec. 11, .	3 33	2 14	1 71	1 62	.92	900
Dec. 17 to Dec. 27, .	1 78	1 02	81	97	1.05	907
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	2.54	911
Jan. 29 to Feb. 19, .	4 36	2 24	1 79	2 57	1.28	940
Mar. 19 to Apr. 2, .	4 36	1 68	1 34	3 02	2.09	935
Apr. 9 to Apr. 22, .	3 28	1 47	1 18	2 10	1.61	990
Apr. 30 to May 21, .	5 34	3 22	2 58	2 76	1.25	935
Total, . .	$32 39	$15 33	$12 26	$20 13	–	–

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Nov. 1 to Nov. 15, .	$3 86	$1 70	$1 36	$2 50	1.11	1,020
Nov. 20 to Dec. 11, .	3 36	2 17	1 74	1 62	.63	958
Dec. 17 to Dec. 27, .	1 70	97	78	92	.77	940
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	1.99	970
Jan. 29 to Feb. 19, .	4 49	2 31	1 85	2 64	1.04	978
Mar. 1 to Mar. 11, .	3 65	1 60	1 28	2 37	1.58	1,030
Mar. 19 to Apr. 2, .	4 47	1 70	1 36	3 11	1.89	1,000
Total, . .	$27 61	$12 31	$9 86	$17 75	–	–

Melia.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Nov. 1 to Nov. 15, .	$3 72	$1 65	$1 32	$2 40	1.67	1,075
Nov. 20 to Dec. 11, .	3 10	1 93	1 54	1 56	.99	1,036
Dec. 17 to Dec. 27, .	1 65	94	75	90	1.26	1,025
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	3.15	1,075
Jan. 29 to Feb. 19, .	4 22	2 16	1 73	2 49	1.57	1,096
Total, . .	$18 77	$8 54	$6 83	$11 94	–	–

Daisy.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Nov. 1 to Nov. 15, .	$4 08	$1 78	$1 42	$2 66	1.80	1,170
Nov. 20 to Dec. 11, .	3 44	2 24	1 79	1 65	1.18	1,165
Dec. 17 to Dec. 27, .	1 90	1 10	88	1 02	1.71	1,176
Jan. 3 to Jan. 18, .	5 34	1 58	1 26	4 18	4.29	1,220
Total, . .	$14 76	$6 70	$5 35	$9 41	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Minnie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 58	$1 60	$1 28	$2 30	1.96	1,050
Nov. 20 to Dec. 11, .	3 00	1 85	1 48	1 52	1.12	1,017
Total, . .	$6 58	$3 45	$2 76	$3 82	–	–

Flora.

Jan. 3 to Jan. 21, .	$6 06	$1 85	$1 48	$4 58	1.58	882
Jan. 29 to Feb. 19, .	4 12	2 10	1 68	2 44	.83	859
Mar. 1 to Mar. 14, .	3 06	1 39	1 11	1 95	1.16	870
Mar. 19 to Apr. 2, .	4 37	1 68	1 34	3 03	1.54	875
Apr. 9 to Apr. 22, .	3 41	1 52	1 22	2 19	1.20	927
Apr. 30 to May 21, .	5 53	3 34	2 67	2 86	.97	918
Total, . .	$26 55	$11 88	$9 50	$17 05	–	–

Jessie.

Jan. 29 to Feb. 19, .	$4 46	$2 29	$1 83	$2 63	0.85	736
Mar. 1 to Mar. 14, .	3 10	1 40	1 12	1 98	1.23	730
Mar. 19 to Apr. 2, .	4 51	1 72	1 38	3 13	1.78	751
Apr. 9 to Apr. 22, .	3 49	1 54	1 23	2 26	1.26	806
Apr. 30 to May 21, .	5 70	3 47	2 78	2 92	1.00	809
Total, . .	$21 26	$10 42	$8 34	$12 92	–	–

Elsie.

Mar. 19 to Apr. 2, .	$4 59	$1 74	$1 39	$3 20	1.56	1,105
Apr. 9 to Apr. 22, .	3 74	1 64	1 31	2 43	1.42	1,120
Apr. 30 to May 21, .	6 23	3 80	3 04	3 19	1.17	1,120
Total, . .	$14 56	$7 18	$5 74	$8 82	–	–

Analyses of Milk.

[Per cent.]

Annie.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids,	13.68	15.22	14.83	14.10	14.30	14.25	14.52	14.06	14.18
Fat,	3.65	5.10	4.90	4.10	4.55	4.61	4 72	4.60	4.67
Solids not fat,	10.03	10.12	9.93	10.00	9.75	9.64	9.80	9.46	9.51

May.

Solids,	14.90	14.42	15.37	15.42	15.05	–	15.02	15.24	14.61
Fat,	4.13	5.30	4.74	4.60	4.65	–	4.60	5.20	4.87
Solids not fat,	10.77	9.12	10.63	10.82	10.40	–	10.42	10.04	9.74

Eva.

Solids,	14.40	14.45	15.11	14.90	14.95	15.52	15.63	–	–
Fat,	4.85	5.25	5.17	4.82	4.95	5.51	5.33	–	–
Solids not fat,	9.55	9.20	9.94	10.08	10.00	10.01	10.30	–	–

Melia.

Solids,	13.82	13.87	14.40	13.86	13.30	–	–	–	–
Fat,	3.70	4.38	4.34	3.50	3.80	–	–	–	–
Solids not fat,	10.12	9.49	10.06	10.36	9.50	–	–	–	–

Daisy.

Solids,	15.48	14.18	16.70	15.73	–	–	–	–	–
Fat,	4.44	4.48	4.93	3.24	–	–	–	–	–
Solids not fat,	11.04	9.70	11.77	12.49	–	–	–	–	–

Minnie.

Solids,	14.22	14.07	–	–	–	–	–	–	–
Fat,	4.49	4.85	–	–	–	–	–	–	–
Solids not fat,	9.73	9.22	–	–	–	–	–	–	–

ANALYSES OF MILK — *Concluded.*

Flora.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids, . .	–	–	–	12.90	12.77	13.15	13.17	12.57	12.77
Fat, . . .	–	–	–	3.15	3.55	3.68	3.73	3.40	3.46
Solids not fat, .	–	–	–	9.75	9.22	9.47	9.44	9.17	9.31

Jessie.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids, . .	–	–	–	–	13.22	13.75	15.12	14.91	15.00
Fat, . . .	–	–	–	–	4.25	4.57	5.34	5 45	4.67
Solids not fat, .	–	–	–	–	8.97	9.18	9.78	9.46	10.33

Elsie.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids, . .	–	–	–	–	–	–	12.20	12.75	12.65
Fat, . . .	–	–	–	–	–	–	3.14	3.09	3.38
Solids not fat, .	–	–	–	–	–	–	9.06	9.66	9.27

ANALYSES OF FODDER ARTICLES FED DURING THE PREVIOUSLY DESCRIBED FEEDING EXPERIMENTS. (NOVEMBER, 1888, TO MAY, 1889.)

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.89	257.80	–	–	1 : 9.01
Dry matter,	87.11	1,742.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.36	27.20	–	–	
" cellulose,	1.90	38.00	12.92	34	
" fat,	4.16	83.20	63.23	76	
" protein (nitrogenous matter),	11.12	222.40	189.04	85	
Non-nitrogenous extract matter,	81.46	1,629.20	1,531.45	94	
	100.00	2,000.00	1,796.64	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.08	201.60	–	–	1 : 3.80
Dry matter,	89.92	1,798.40	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.38	127.60	–	–	
" cellulose,	10.74	214.80	42.96	20	
" fat,	4.34	86.80	69.44	80	
" protein (nitrogenous matter),	17.77	355.40	312.75	88	
Non-nitrogenous extract matter,	60.77	1,215.40	972.32	80	
	100.00	2,000.00	1,397.47	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.22	204.40	–	–	1 : 2.74
Dry matter,	89.78	1,795.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.52	10.40	–	–	
" cellulose,	.56	11.20	3.81	34	
" fat,	5.50	110.00	83.60	76	
" protein (nitrogenous matter),	30.15	603.00	512.55	85	
Non-nitrogenous extract matter,	63.27	1,265.40	1,189.48	94	
	100.00	2,000.00	1,789.44	–	

Hay.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.06	161.20	–	–	1 : 9.05
Dry matter,	91.94	1,838.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.67	133.40	–		
" cellulose,	33.75	675.00	391.50	58	
" fat,	2.09	41.80	19.23	46	
" protein (nitrogenous matter),	10.06	201.20	114.68	57	
Non-nitrogenous extract matter,	47.43	948.60	597.62	63	
	100.00	2,000.00	1,123.03	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Corn Fodder.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	36.85	737.00	–	–	1 : 8.46
Dry matter,	63.15	1,263.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	4.84	96.80	–	–	
" cellulose,	21.96	439.20	316.22	72	
" fat,	2.02	40.40	30.30	75	
" protein (nitrogenous matter),	9.82	196.40	143.37	73	
Non-nitrogenous extract matter,	61.36	1,227.20	822.22	67	
	100.00	2,000 00	1,312.11	–	

Corn Stover.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	50.13	1,002.60	–	–	1 : 10.78
Dry matter,	49.87	997.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.73	74.60	–	–	
" cellulose,	34.49	689.80	496.66	72	
" fat,	1.75	35.00	26.25	75	
" protein (nitrogenous matter),	8.00	160.00	116.80	73	
Non-nitrogenous extract matter,	52.03	1,040.60	697.20	67	
	100.00	2,000.00	1,336.91	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Carrots (Danvers).

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	90.05	1,801.00	–	–	
Dry matter,	9.95	199.00	–	–	
	100.00	[illegible]	–	–	
Analysis of Dry Matter.					
Crude ash,	8.28	[illegible]	–	–	1 : 9.17
" cellulose,	10.26	205.20	205.20	[illegible]	
" fat,	1.67	33.40	33.40	100	
" protein (nitrogenous matter),	[illegible]	159.60	159.60	100	
Non-nitrogenous extract matter,	71.81	1,436.20	1,436.20	[illegible]	
	100.00	2,000.00	1,834.40	–	

Corn Ensilage.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	[illegible]	[illegible]	–	–	
Dry matter,	[illegible]	[illegible]	–	–	
	[illegible]	[illegible]	–	–	
Analysis of Dry Matter.					
Crude ash,	[illegible]	[illegible]	–	–	[illegible]
" cellulose,	[illegible]	[illegible]	[illegible]	[illegible]	
" fat,	[illegible]	[illegible]	[illegible]	[illegible]	
" protein (nitrogenous matter),	[illegible]	[illegible]	[illegible]	[illegible]	
Non-nitrogenous extract matter,	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Sugar Beets (Average).

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	87.21	1,744.20	–	–	1 : 8.36
Dry matter,	12.79	255.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.47	129.40	–	–	
" cellulose,	6.16	123.20	123.20	100	
" fat,	.98	19.60	19.60	100	
" protein (nitrogenous matter),	10.15	203.00	203.00	100	
Non-nitrogenous extract matter,	76.24	1,524.80	1,524.80	100	
	100.00	2,000.00	1,870.60	–	

Rowen.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.95	219.00	–	–	1 : 6.28
Dry matter,	89.05	1,781.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.49	129.80	–	–	
" cellulose,	31.50	630.00	365.40	58	
" fat,	5.03	100.60	46.28	46	
" protein (nitrogenous matter),	14.25	285.00	162.45	57	
Non-nitrogenous extract matter,	42.73	854.60	538.40	63	
	100.00	2,000.00	1,110.53	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Concluded.*

Corn Fodder.

[Mostly stalks; left uneaten by the cows during experiment.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	53.70	1,074.00	–	–	1 : 13.92
Dry matter,	46.30	926.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.44	68.80	–	–	
" cellulose,	39.31	786.20	566.06	72	
" fat,	2.83	56.60	42.45	75	
" protein (nitrogenous matter),	6.47	129.40	94.46	73	
Non-nitrogenous extract matter,	47.95	959.00	642.53	67	
	100.00	2,000.00	1,345.50	–	

Corn Stover.

[Mostly stalks; left uneaten by the cows during experiment.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	62.85	1,257.00	–	–	1 : 15 30
Dry matter,	37.15	743.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.36	47.20	–	–	
" cellulose,	37.52	750.40	540.29	72	
" fat,	3.50	70.00	52.50	75	
" protein (nitrogenous matter),	5.94	118.80	86.72	73	
Non-nitrogenous extract matter,	50.68	1,013.60	679.11	67	
	100.00	2,000.00	1,358.62	–	

SUMMARY OF FEEDING EXPERIMENTS WITH MILCH COWS. (NOVEMBER, 1885, TO MAY, 1889.)

Fodder Corn, Corn Stover and Corn Ensilage vs. English Hay.

In preceding communications it will be found that some years ago, November, 1885, a series of observations with milch cows was inaugurated at our institution, for the purpose of securing, under well-defined circumstances, information needed to assist in answering the following questions: —

1. What is the comparative feeding effect of dry fodder corn, of dry corn stover, and of a good corn ensilage, when used in part or in the whole as a substitute for English hay (upland meadow hay) in the daily diet of milch cows, and also that of a good root crop in place of corn ensilage; the amount and kind of grain feed remaining, for obvious reasons, the same under otherwise corresponding circumstances?

2. What is the *total cost*, as well as the *net cost* of the *daily feed* per head in case of different fodder combinations used; making in all cases alike an allowance of a loss of twenty per cent. of the fertilizing constituents contained in the feed consumed, in consequence of the sale of the milk?

3. What is the commercial value, at current market rates, of the manurial refuse obtainable in the case of different fodder combinations used as daily diet for the support of cows, assuming that eighty per cent. of the value of the fertilizing constituents contained in the fodder consumed can be secured to the farm by a careful management?

The results of experiments carried on in this connection during a number of months of the years 1885, 1886, 1887 and 1888, have already been described in detail in our respective annual reports and periodical bulletins. More recent observations in the same direction are reported upon some preceding pages.

As a careful consideration of all our results to date leads practically to the same conclusions, the subsequent final summary of our work has been prepared with a view of enabling, as far as practicable, all parties interested in our special line of inquiry into the economy of milk production to draw their own conclusions, and to ascertain for themselves whether the stand-point taken in our several reports, of progress, is justifiable by the facts presented.

RECORD OF FEEDING EXPERIMENTS.

*November, 1885, to May, 1889.**

Period of Observation.	Fodder Articles consumed, and Their Cost per Ton.		Nutritive Character of Feed (Nutritive Ratio).	Names of Cows on Trial.	Variations in the Daily Yield of Milk (Quarts).	Average Production of Milk per Day during the Entire Period (Quarts).	Variations in the Total Cost of Feed per Quart of Milk produced (Cents).	Variations in the Net Cost of Feed per Quart of Milk produced (Cents).	Variations in the Amount of Dry Matter in the Feed consumed per Quart of Milk (Pounds).
Nov. 20, 1885, to July 4, 1886.	Corn meal,	$23 00							
	Wheat bran,	20 00							
	English hay,	15 00	1 : 6.7 to 1 : 10.17	1. Daisy (1)	16.3 – 8.4	12.77	.97–2.64	.50–1.64	1.44–2.86
	Corn stover,	5 00	Mean, 1 : 7.86	2. Mollie	12.62– 8.60	11.00	1.02–2.50	.51–1.61	1.56–2.80
	Corn ensilage,	2 75							
	Sugar beets,	5 00							
Oct. 1, 1886, to April 24, 1887.	Corn meal,	$23 00							
	Wheat bran,	20 00							
	Gluten meal,	23 00		1. Susie	13.5 – 9.4	11.92	1.04–2.37	.43–1.67	1.66–2.76
	Rye middlings,	24 00	1 : 5.99 to 1 : 7.90	2. Meg	13.9 –10.3	11.93	.95–2.76	.41–1.96	1.72–2.43
	English hay,	15 00	Mean, 1 : 6 60	3. Dora	16.3 –11.7	13.94	.85 2.26	.34–1.60	1.58–2.23
	Corn stover,	5 00							
	Corn ensilage,	2 75							
	Carrots,	7 00							

* For more details, consult the respective annual reports on the work of this station.

RECORD OF FEEDING EXPERIMENTS.

*November, 1885, to May, 1889.**

Period of Observation.	Fodder Articles consumed, and Their Cost per Ton.		Nutritive Character of Feed (Nutritive Ratio).	Names of Cows on Trial.	Variations in the Daily Yield of Milk (Quarts).	Average Production of Milk per Day during the Entire Period (Quarts).	Variations in the Total Cost of Feed per Quart of Milk produced (Cents).	Variations in the Net Cost of Feed per Quart of Milk produced (Cents).	Variations in the Amount of Dry Matter in the Feed consumed per Quart of Milk (Pounds).
Jan. 8, 1888, to May 15, 1888.	Corn meal,	$23 00	1 : 5.20 to 1 : 6.10 Mean, 1 : 5.80	1. May (1)	12.3-10.1	11.23	1.51–2.51	.77–1.63	1.94–2.50
	Wheat bran,	20 70		2. Minnie (1)	12.7–10.2	11.49	1.40–2.53	.74–1.65	1.73–2.52
	Gluten meal,	27 00		3. Melia (1)	14.6–10.9	12.62	1.28–2.44	.66–1.59	1.73–2.43
	Corn and cob meal,	20 70		4. Eva (1)	7.2– 5.5	6 22	2 58–4 74	1.39–3.09	3.36–4.74
	English hay,	15 00		5. Lizzie	10.6– 7.9	9.06	1.68–3.36	.95–2.19	2.17–3.35
	Corn stover,	5 00		6. Daisy (2)	19.2–13.5	16.22	1.01–1.97	.50–1.28	1.38–1.96
	Corn ensilage,	2 75							
	Fodder corn,	5 00							
Nov. 1, 1888, to May 21, 1889.	Corn meal.	$21 90	1 : 5.13 to 1 : 6.79 Mean, 1 : 6.02	1. Annie	10.68– 7.09	9.65	1.66–3.04	.83–2.28	2.00–2.48
	Wheat bran,	20 70		2. May (2)	10.13– 8.05	9.21	1.88–3.36	.92–2.54	2.29–2.67
	Gluten meal,	23 40		3. Eva (2)	14.95–10.73	11.79	1.30–2.72	.63–1.99	1.67–2.49
	English hay,	15 00		4. Daisy (3)	9.87– 5.43	6.95	2.46–5.48	1.18–4.29	2.93–4 04
	Fodder corn,	5 00		5. Jessie	14.12–11.46	12.84	1.43–2.56	.85–1.78	1.70–2.04
	Corn stover,	5 00		6. Melia (2)	9.60– 7.17	7.05	1.97–4.18	.99–3.15	2.39–3.05
	Corn ensilage,	2 75		7. Elsie	13.64–12.25	12.71	2.18–2.29	1.17–1.56	1.78–2.39
	Carrots,	7 00		8. Minnie (2)	7.83– 6.15	6.83	2 22–3.05	1.12–1.96	2 61–3.16
	Sugar beets,	5 00		9. Flora	15.30–12.05	13.82	1.41–2.22	.83–1.58	1.42–1.95
	Rowen,	15 00							

* For more details, consult the respective annual reports on the work of this station.

A short discussion of the most important facts presented in the preceding tabular statement may assist in a desirable appreciation of the questions involved.

During our first year of observation, November, 1885, to July, 1886, either corn meal and wheat bran or wheat bran alone served as grain feed; while, during the succeeding years, as a rule, the same weight parts of corn meal, wheat bran and gluten meal were fed.

The above-stated variations of daily yield of milk refer to the highest and lowest yield in each case, and do not bear a direct relation to any particular diet.

The valuation of the fodder ingredients is based in this connection on the average of the local market price per ton of each article for the entire period of observation.

Corn meal,	$22 75	Fodder corn,	$5 00
Wheat bran,	21 00	Corn stover,	5 00
Gluten meal,	24 50	Corn ensilage,	2 75
Hay,	15 00	Carrots,	7 00
Rowen,	15 00	Sugar beets,	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4¼ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management, while twenty per cent. is assumed to be sold with the milk.

Principal Daily Fodder Rations used.

November, 1885, to July, 1886.

1.		2.	
Corn meal,	3.25 lbs.	Corn meal,	3.25 lbs.
Wheat bran,	3.25 "	Wheat bran,	3.25 "
Hay,	21.75 "	Hay,	10.00 "
Total cost,	23.43 cts.	Corn stover,	8.00 "
Net cost,	15.43 "	Total cost,	16.62 cts.
Manurial value obtainable,	8.00 "	Net cost,	10.04 "
Nutritive ratio,	1:8.02	Manurial value obtainable,	6.58 "
		Nutritive ratio,	1:7.83

Principal Daily Fodder Rations used — *Continued.*

3.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	5 00 "
Corn stover,	12.75 "
Total cost,	14.06 cts.
Net cost,	7.83 "
Manurial value obtainable,	6 23 "
Nutritive ratio,	1:7.81

4.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	15.00 "
Sugar beets,	27.00 "
Total cost,	25.12 cts.
Net cost,	17.10 "
Manurial value obtainable,	8.02 "
Nutritive ratio,	1:7.20

5.

Wheat bran,	3.25 lbs.
Hay,	15.00 "
Sugar beets,	27.00 "
Total cost,	21.41 cts.
Net cost,	14.31 "
Manurial value obtainable,	7.10 "
Nutritive ratio,	1:6.93

6.

Wheat bran,	3.25 lbs.
Hay,	15.00 "
Sugar beets,	40.00 "
Total cost,	24.66 cts.
Net cost,	16.66 "
Manurial value obtainable,	8.00 "
Nutritive ratio,	1:6.81

October, 1886, to April, 1887.

7.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	18.75 "
Total cost,	25.14 cts.
Net cost,	15.77 "
Manurial value obtainable,	9.37 "
Nutritive ratio,	1:6.11

8.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	5.00 "
Corn ensilage,	34.00 "
Total cost,	19 60 cts.
Net cost,	11.62 "
Manurial value obtainable,	7.98 "
Nutritive ratio,	1:6.12

9.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Carrots,	38.00 "
Total cost,	31.89 cts.
Net cost,	23.05 "
Manurial value obtainable,	8.84 "
Nutritive ratio,	1:5.99

PRINCIPAL DAILY FODDER RATIONS USED — *Concluded.*

January to May, 1888.

10.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Fodder corn,	17.75 "
Total cost,	15.53 cts.
Net cost,	7.54 "
Manurial value obtainable,	7.99 "
Nutritive ratio,	1:5 82

11.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Corn stover,	17.25 "
Total cost,	15.40 cts.
Net cost,	7.44 "
Manurial value obtainable,	7.96 "
Nutritive ratio,	1:5.98

12.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Corn ensilage,	21.75 "
Total cost,	21.64 cts.
Net cost,	13.15 "
Manurial value obtainable,	8.49 "
Nutritive ratio,	1:6.12

November, 1888, to May, 1889.

13.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Sugar beets,	47.25 "
Total cost,	30 40 cts.
Net cost,	20.22 "
Manurial value obtainable,	10.18 "
Nutritive ratio,	1:5.56

14.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Rowen,	19.50 "
Total cost,	25.72 cts.
Net cost,	13.51 "
Manurial value obtainable,	12.21 "
Nutritive ratio,	1:5.06

Fodder rations Nos. 3, 8, 10, 11 and 14 deserve particular attention for trials. The remainder, although in some instances not without special interest, are published to illustrate our essential variations in the daily diet used.

TABULAR STATEMENT OF THE COST PER DAY OF THE ABOVE-MENTIONED FODDER COMBINATIONS.

	Total Cost.	Net Cost.	Manurial Value Obtainable.
	Cents.	Cents.	Cents.
No. 1,	23.43	15.43	8.00
" 2,	16.62	10.04	6.58
" 3,	14.06	7.83	6.23
" 4,	25.12	17.10	8.02
" 5,	21.41	14.31	7.10
" 6,	24.66	16.66	8.00
" 7,	25.14	15.77	9.37
" 8,	19.60	11.62	7.98
" 9,	31.89	23.05	8.84
" 10,	15.75	7.54	7.99
" 11,	15.40	7.44	7.96
" 12,	21.64	13 15	8.49
" 13,	30.40	20.22	10.18
" 14,	25.72	13.51	12.21

Considering the previously described fodder combinations from a mere financial stand-point, they rank, with reference to their net cost, beginning with the lowest, as follows: 11, 10, 3, 2, 8, 12, 14, 5, 1, 7, 6, 4, 13, 9. A close inquiry into the character of the coarser or bulky part of the various fodder compositions cannot fail to show that, wherever fodder corn, corn stover or corn ensilage have been fed in part or in the whole as a substitute for English hay, in connection with the same kind and amount of grain feed, the commercial value of the manurial refuse obtainable has been but slightly if any affected; while the net cost of the daily feed of the animals on trial has been materially reduced (from one-third to one-half). It seems scarcely necessary to mention, here, that only equally well-prepared fodder articles are considered in the discussion.

Sugar beets compare well, as far as net cost is concerned, with good corn ensilage, when fed in quantities of from twenty to twenty-five pounds of the former in place of from thirty to thirty-five pounds of the latter.

In view of these facts, it becomes a question of first importance to ascertain to what extent it will be judicious, as far as their commercial feed value is concerned, to advo-

cate the substitution of dry fodder corn, corn stover and a good corn ensilage for English hay in the daily diet of dairy stock.

It is generally admitted that the present condition of the market for dairy products calls for the closest investigation of every point which bears on the cost of the production of milk; and it will be not less conceded, that next in importance to the selection of cows of good milking qualities comes the consideration of the cost of their daily diet.

Net Cost of Feed.

The actual cost of a daily diet for any kind of farm live stock does not alone depend on the temporary market cost of a given quantity of the various ingredients which constitute the daily fodder rations, but also in a controlling degree upon the quantity of some essential articles of plant food (in particular of nitrogen, phosphoric acid and potassium oxide) which they contain, and the amount of these which may be secured in some definite proportion in form of manurial refuse, after the fodder has served its purpose for the support of the life and the functions of the animal which consumes it. As has been already stated on previous occasions, the net cost of a daily diet is ascertained by deducting from the sum of the market price of its ingredients, the sum expressing the commercial value of their manurial constituents obtainable in each particular case. This circumstance deserves, for obvious reasons, the most serious consideration on the part of farmers, when choosing from among the various suitable fodder articles offered for their patronage, those for a daily diet of their farm live stock which will ultimately prove the cheapest in their position, in consequence of the higher commercial value of the manurial refuse they furnish.

It becomes the more important to select with that view in mind; as the fluctuations in the local market price of oil cakes, gluten meal, corn meal, wheat bran and of similar refuse materials (by-products) of flour mills, glucose works, starch works, breweries, etc., are, as a rule, liable to be more frequent and more serious than in case of home-raised coarse or bulky fodder articles, as English hay, corn stover,

corn ensilage, etc. The commercial value of the manurial refuse obtainable from the first-named class, in case of corresponding weights and under similar circumstances, exceeds quite frequently from two to three times that obtainable in case of the latter.

Applying this standard of valuation to our feeding experiments, we notice the following relations: —

Fodder Articles used during our Feeding Experiments.

Name of Article.	Market Price per Ton.	Value of Manurial Constituents per Ton.	Relative Net Cost per Ton.
English hay,	$15 00	$5 58	$10 54
Rowen (dry),	15 00	9 83	7 14
Fodder corn (dry),	5 00	4 53	1 38
Corn stover (dry),	5 00	3 21	2 43
Corn ensilage,	2 75	1 56	1 50
Corn meal,	21 90	6 51	16 69
Wheat bran,	20 70	13 64	9 79
Gluten meal,	23 40	15 23	11 22

Considering our entire feeding experiments, 1885 to 1889, we find that corn meal has cost per ton $22.75, wheat bran $21, and gluten meal $24.50. The latter sells to-day at $23 per ton, corn meal at $19, and wheat bran at $16.50. The market price of hay, corn stover, etc., has practically remained the same, as far as the same season of the year is concerned. Serious variations in the market price of our fodder articles not infrequently advise changes from one article to another of a similar character and composition. At present local market prices of feed stuffs, hay and corn meal are very costly fodder articles; the same applies to carrots.

Feeding Value or Nutritive Value of Fodder Articles.

From preceding remarks it will be apparent that we have secured a satisfactory basis for our guidance to decide the relative money value of current fodder articles, as well as that of an entire diet. Quite different, however, is our situation, when the determination of their relative feeding

value is involved; for it is an undeniable fact that the relative commercial value of fodder articles does not necessarily coincide with their relative feeding value; it rarely does. This circumstance arises from the fact that both are determined by different standards. The *commercial* or *money value* of *fodder articles*, as far as they enter the general market, is regulated like that of other articles of merchandise, by supply and demand; the greater the former and the less the latter, the lower is the market price, etc.; the relative money value of a given quantity can be expressed for the same locality by one definite sum.

The *feeding value* or *nutritive value* of a *fodder article* refers especially to its feeding effect; it depends usually on the co-operation of a series of varying conditions, sometimes more or less beyond our control. Foremost among these are: —

1. A higher degree of adaptation with reference to particular kind and organization of the animal under consideration; its age and functions, etc.

2. The chemical composition and the general physical conditions, depending on stage of growth, mechanical preparation, etc., of the fodder ingredients to be used.

3. Whether the article constitutes the sole diet, or serves as a more or less prominent part of the daily diet. The feeding effect of most fodder articles is more or less modified by, and thus in a controlling degree dependent on, the character of the associated ingredients in the daily diet.

These few remarks suffice to show that the comparative feeding value of one and the same fodder article, even when of a stable composition, cannot be fully expressed by one numerical value. The practice of stating the comparative feeding value of current fodder articles with reference to that of good English hay equal to 100, has been for years abandoned, as devoid of any substantial support. There is no single fodder article on record which furnishes the best diet — *i. e.*, the cheapest and at the same time most nutritive food — for even the same class of animals, under different circumstances. Both net cost of feed and its relative nutritive or feeding effect under existing circumstances, have to be consulted when aiming at an economical diet for farm

live stock. Actual feeding experiments, under well-defined circumstances, alone can give us the desired information.

Although much needs still to be done in this direction to recognize in many instances more clearly the principles which underlie a successful practice, it must be admitted that some valuable facts have been already established in regard to a rational and thus economical system of stock feeding, by European investigators and others, which can serve advantageously as guides in compounding economical fodder combinations for all kinds of farm live stock. The economy of milk production, in particular, has received much attention. European investigators recommend in this connection quite generally a daily diet, rich in digestible nitrogenous constituents, as beneficial to the general condition of cows, and at the same time reducing the net cost of the feed consumed, by furnishing larger quantities of valuable home-made manure at the lowest market cost. The European standard for a daily diet of milch cows calls for one part of digestible nitrogenous fodder constituents to five and four-tenths parts of digestible non-nitrogenous food constituents. Our results, on the whole, point in the same direction. The nitrogenous food constituents of the fodder rations received special attention.

The main interest of our inquiry, however, consists in the partial or entire successful substitution, under otherwise corresponding circumstances, of dry fodder corn or corn stover or corn ensilage for English hay, as far as net cost of feed and quality and quantity of milk are concerned. The results of former years of observation are already on record in our respective annual reports; they lead to the same conclusions as those stated in the introduction to our latest experiment, described in preceding pages. The net cost of the daily feed during our late experiment has been reported in that connection. The quality of the milk and cream obtained on that occasion may be learned from the subsequent tabular creamery records of the station. (See "Feeding Experiment," chapter IV., creamery record of the Massachusetts State Agricultural Experiment Station during the years 1885 to 1889, contained in this report.)

II. Feeding Experiments with Milch Cows; Green Crops *vs.* English Hay. June 19 to Oct. 22, 1889.

The first experiment in this direction was instituted in 1887, for the purpose of comparing the feeding effects of good English hay with that of some reputed green fodders. The green crops selected for our observation consisted of a mixed crop of oats and vetch, of Southern cow-pea and of serradella.

1887. — Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, 3¼ pounds (2 quarts); wheat bran, 3¼ pounds (4 quarts); English hay, 20 to 24 pounds. The excess of hay left over was weighed back and subsequently deducted from the original quantity (about ⅓ to ½ pound per day).

Three cows received periodically the above-stated daily rations, and alternately the following: corn meal, 3¼ pounds; wheat bran, 3¼ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-pea, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period. The rate of consumption of green crops decreased gradually with the progress of their growth.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the fifth annual report of the station.

1888. — The experiment was repeated with some modifications. A mixed crop of vetch and oats, of Southern cow-pea and of serradella, was raised for that purpose. The latter crop suffered seriously from blight, and was not fit for feeding.

The quantity of green fodder fed at stated times was somewhat less in pounds than in the trial during the preceding year, on account of the addition of gluten meal to the fodder ration of that year. The daily diet (1888)

consisted of corn meal, $3\frac{1}{4}$ pounds; wheat bran, $3\frac{1}{4}$ pounds; gluten meal, $3\frac{1}{4}$ pounds; English hay, 5 pounds; and as much vetch and oats or cow-pea as the animal would consume, which amounted, in the case of green vetch and oats, to from 54 to 68 pounds; and in that of green Southern cow-pea, from 70 to 80 pounds. One-fourth (five pounds) of the ordinary daily hay ration was retained in our green fodder diet, for the purpose of preventing disorders in the digestion of a liberal quantity of green fodder.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15 per ton; allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre. This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Fodder Articles. (1888.)

Corn meal,	$24 00	Vetch and oats (green),	$2 75
Corn and cob meal,	20 70	Cow-pea (green),	3 14
Wheat bran,	22 50	Serradella (green),	3 16
Gluten meal,	22 50	Rowen,	15 00
English hay,	15 00		

1889. — Six cows at a time served in the trial; the observation began in June and closed in October, 1889. The course adopted during the preceding year was adhered to in every essential point. The daily diet consisted of $3\frac{1}{4}$ pounds each of corn meal, wheat bran and gluten meal, with 5 pounds of hay, and all the green vetch and oats, green cow-pea or green serradella called for by each individual

cow. The amount actually consumed per day varied in case of vetch and oats from 30 to 55 pounds; of cow-pea, from 66 to 84 pounds; and, in case of serradella, from 63 to 85 pounds; showing but little preference for one as compared with the others. The difference in the daily consumption of the green fodders was due largely to their variations in dry vegetable matter during the progress of the experiment. The experiment was sub-divided into five feeding periods, beginning and ending with a hay fodder ration. The daily waste of coarse feed amounted per head to four pounds in case of oats and vetch, to two pounds in case of serradella, to one and one-half pounds in case of cow-pea; and, in case of hay, to one-half pound.

The results obtained fully sustain the conclusions presented in our previous reports, namely:—

1. The weight of dry vegetable matter contained in the feed consumed for the production of one quart of milk is less in case of the green fodder rations than in the hay ration; indicating a superior nutritive value of the former, as compared with the latter.

2. The yield of milk is in every instance increased, when changing from a hay ration to a green fodder ration.

3. The quality of milk is but slightly altered in case of different cows; the solids in some instances are slightly increased, in others they are slightly decreased. The creamery record, as will be seen from subsequent abstracts, is very satisfactory in case of the green fodder rations.

4. The net cost of feed for the production of milk is in every instance less in case of green fodder rations than in the hay ration.

5. The weight of the animal has in most instances increased towards the close of the experiment.

Valuation of Fodder Articles for the Months of June to October of the Year 1889.

	Per Ton.		Per Ton.
Corn meal,	$19 00	Cow-pea,	$3 14
Wheat bran,	18 50	Serradella,	3 16
Gluten meal,	22 00	Hay,	15 00
Vetch and oats,	2 75		

FEEDING RECORD.

JESSIE: *Age, five years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day. Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
1889.												
June 19 to June 27, ...	3.25	3.25	3.25	18.70	–	–	–	25.56	10.90	2.34	1 : 6.23	819
July 2 to July 15, ...	3.25	3.25	3 25	3.64	55.43	–	–	23.89	10.59	2.26	1 : 6.52	833
Sept. 1 to Sept. 10, ...	3.25	3.25	3.25	5.00	–	84.30	–	27.43	11.74	2.34	1 : 6.12	823
Sept. 15 to Sept. 27, ...	3.25	3.25	3.25	5.00	–	–	85.77	27.18	11.00	2.47	1 : 4.68	805
Oct. 4 to Oct. 22, ...	3.25	3.25	3.25	19.74	–	–	–	26.50	9.51	2.79	1 : 6.29	855

FLORA: *Age, five years; grade, Durham; last calf, Dec. 22, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
June 19 to June 24, ...	3.25	3.25	3.25	18.80	–	–	–	25.65	11.71	2.19	1 : 6.24	940
July 2 to July 15, ...	3.25	3.25	3.25	5.00	30.14	–	–	19.71	10.01	1.97	1 : 6.01	904
Sept. 1 to Sept. 10, ...	3.25	3.25	3.25	5.00	–	80.90	–	26.85	13.51	1.99	1 : 6.07	932
Sept. 15 to Sept. 27, ...	3.25	3.25	3.25	5.00	–	–	79.54	26.16	11.72	2.23	1 : 4.70	930
Oct. 4 to Oct. 22, ...	3.25	3.25	3.25	17.79	–	–	–	24.74	10.69	2.31	1 : 6.17	974

FEEDING RECORD — *Continued.*

EVA: *Age, nine years; grade, Jersey; last calf, Oct. 7, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27,	3.25	3.25	3.25	17.20	–	–	–	24.20	10.04	2 41	1 : 6.13	1,044
July 2 to July 15,	3.25	3.25	3.25	5.00	41.79	–	–	22.24	9.88	2.25	1 : 6.30	1,039
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	83.50	–	27.30	11.41	2.39	1 : 6.11	1,015
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	82.46	26.64	9.13	2.92	1 : 4.69	1,039
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19 26	–	–	–	26.07	8.21	3.18	1 : 6.26	1,078

ANNIE: *Age, six years; grade, Jersey; last calf, June 19, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
June 19 to June 27,	3.25	3.25	3.25	16.00	–	–	–	23.12	10.03	2.31	1 : 6.06	909
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	66.30	–	24.38	10.64	2.29	1 : 5.97	903
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5 00	–	–	63.15	23.48	9.04	2.60	1 : 4.74	898
Oct. 4 to Oct. 22,	3.25	3.25	3.25	17.32	–	–	–	24.31	8.39	2.90	1 : 6.14	936

FEEDING RECORD — *Concluded.*

ELSIE: *Age, six years; grade, Holstein; last calf, Feb. 26, 1889.*

Feeding Periods.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27,	3.25	3.25	3.25	20.00	–	–	–	26.74	10.58	2.53	1 : 6.31	1,148
July 2 to July 15,	3.25	3.25	3 25	5.00	55.29	–	–	25 18	10.25	2 46	1 : 6.60	1,145
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5 00	–	69.60	–	24.94	9.93	2.51	1 : 5.99	1,132
Sept. 15 to Sept. 27,	3.25	3.25	3 25	5.00	–	–	77.08	25.76	9.22	2.79	1 : 4.70	1,141
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19.95	–	–	–	26.69	8.51	3.14	1 : 6.31	1,188

JUNO: *Age, six years; grade, Ayrshire; last calf, June 22, 1889.*

Feeding Periods.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
July 2 to July 15,	3.25	3.25	3.25	5.00	49.36	–	–	23.89	14.74	1.62	1 : 6.47	975
Sept. 1 to Sept. 10,	3 25	3 25	3.25	5.00	–	72.80	–	25 48	14.74	1.73	1 : 6.02	1,014
Sept. 15 to Sept. 27,	3.25	3 25	3.25	5.00	–	–	81.38	26 46	12.93	2.05	1 : 4.69	984
Oct. 4 to Oct. 22,	3.25	3.25	3.25	21.74	–	–	–	28.31	12.15	2.33	1 : 6.40	1,040

TOTAL COST OF FEED PER QUART OF MILK.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Annie.											
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27, ...	90.25	10.03	29.25	29.25	29.25	144.00	–	–	–	$1 95	2.16
Sept. 1 to Sept. 10, ...	106 38	10.64	32.50	32 50	32.50	50.00	–	663.00	–	2 38	2.24
Sept. 15 to Sept. 27, ...	117.50	9.04	42.25	42.25	42.25	65.00	–	–	821 00	3 04	2.59
Oct. 4 to Oct. 22, ...	159.38	8.39	61.75	61.75	61.75	329.00	–	–	–	4 30	2.70
Elsie.											
June 19 to June 27, ...	95.25	10.58	29.25	29.25	29.25	180.00	–	–	–	$2 22	2.33
July 2 to July 15, ...	143.50	10.25	45.50	45.50	45.50	70.00	774.00	–	–	2 94	2.05
Sept. 1 to Sept. 10, ...	99.25	9.93	32.50	32.50	32.50	50.00	–	696.00	–	2 43	2.45
Sept. 15 to Sept. 27, ...	119.88	9.22	42.25	42.25	42.25	65.00	–	–	1,002.00	3 33	2.78
Oct. 4 to Oct. 22, ...	161.63	8.51	61.75	61.75	61.75	379.00	–	–	–	4 68	2.89
Juno.											
July 2 to July 15, ...	206.38	14.74	45.50	45.50	45.50	70.00	691.00	–	–	$2 83	1.37
Sept. 1 to Sept. 10, ...	147.38	14.74	32 50	32.50	32 50	50 00	–	728.00	–	2 49	1.69
Sept. 15 to Sept. 27, ...	168.13	12.93	42.25	42.25	42.25	65.00	–	–	1,058.00	3 42	2.03
Oct. 4 to Oct. 22, ...	230.88	12.15	61.75	61.75	61.75	413.00	–	–	–	4 93	2.14

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Jessie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27, ...	98.13	10.90	29.25	29.55	29.25	168.00	–	–	–	$2 13	2.17
July 2 to July 15, ...	148 25	10.59	45.50	45.50	45.50	51.00	776.00	–	–	2 81	1.89
Sept. 1 to Sept. 10, ...	117.38	11.74	32.50	32.50	32.50	50.00	–	843.00	–	2 67	2.27
Sept. 15 to Sept. 27, ...	143 00	11.00	42.25	42.25	42.25	65.00	–	–	1,115.00	3 51	2.45
Oct. 4 to Oct. 22, ...	180.75	9.51	61.75	61.75	61.75	375.00	–	–	–	4 64	2.56

Flora.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
June 19 to June 24, ...	70.25	11.71	19.50	19.50	19.50	113.00	–	–	–	$1 43	2.04
July 2 to July 15, ...	140.13	10.01	45.50	45.50	45.50	70.00	422.00	–	–	2 46	1.76
Sept. 1 to Sept. 10, ...	135.13	13.51	32.50	32 50	32.50	50.00	–	809.00	–	2 61	1.93
Sept. 15 to Sept. 27, ...	152.38	11.72	42.25	42.25	42.25	65.00	–	–	1,034.00	3 38	2.22
Oct. 4 to Oct. 22, ...	203.13	10.69	61.75	61.75	61.75	338.00	–	–	–	4 37	2.15

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Eva.

FEEDING PERIODS	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27,	90.38	10.04	29.25	29.25	29.25	155.00	–	–	–	$2 03	2.25
July 2 to July 15,	137.38	9.88	45.50	45.50	45.50	70.00	685.00	–	–	2 82	2.06
Sept. 1 to Sept. 10,	114.13	11.41	32.50	32.50	32.50	50.00	–	835.00	–	2 65	2.32
Sept. 15 to Sept. 27,	118.75	9.13	42.25	42.25	42.25	65.00	–	–	1,072.00	3 44	2.90
Oct. 4 to Oct. 22,	156.00	8.21	61.75	61.75	61.75	366.00	–	–	–	4 58	2.94

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents. (1889.)

[Per cent.]

	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.
Moisture,	13.290	10.92	10.19	9.48	78 26	83.07	83.65
Nitrogen,	1.564	2.447	4.230	1.463	.268	.304	.470
Phosphoric acid,	.720	2.900	.392	.303	.112	.098	.112
Potassium oxide,	.434	1.637	.049	1.350	.324	.172	.178
Valuation per 2,000 lbs.,	$6 57	$13 27	$14 90	$6 55	$1 34	$1 31	$1 89

Net Cost of Milk and Manurial Value of Feed.

Jessie.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Lbs.
June 19 to June 27,	$2 13	$0 98	$0 78	$1 35	1.38	838
July 2 to July 15,	2 81	1 48	1 18	1 63	1.10	840
Sept. 1 to Sept. 10,	2 67	1 28	1 02	1 65	1.41	810
Sept. 15 to Sept. 27,	3 51	2 00	1 60	1 91	1.34	820
Oct. 4 to Oct. 22,	4 64	2 30	1 84	2 80	1.55	888
Total,	$15 76	$8 04	$6 42	$9 34	–	–

Flora.

June 19 to June 24,	$1 43	$0 71	$0 57	$0 86	1.22	952
July 2 to July 15,	2 46	1 30	1 04	1 42	1.01	905
Sept. 1 to Sept. 10,	2 61	1 26	1 01	1 60	1.18	938
Sept. 15 to Sept. 27,	3 38	1 92	1 54	1 84	1.21	933
Oct. 4 to Oct. 22,	4 37	2 18	1 74	2 63	1.29	1,000
Total,	$14 25	$7 37	$5 90	$8 35	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Lbs.
June 19 to June 24, .	$2 03	$0 94	$0 75	$1 28	1.42	1,046
July 2 to July 15, .	2 82	1 48	1 18	1 64	1.19	1,030
Sept. 1 to Sept. 10, .	2 65	1 27	1 02	1 63	1.43	1,030
Sept. 15 to Sept. 27, .	3 44	1 96	1 57	1 87	1 58	1,038
Oct. 4 to Oct. 22, .	4 58	2 27	1 82	2 76	1.77	1,109
Total, . .	$15 52	$7 92	$6 34	$9 18	–	–

Annie.

June 19 to June 27, .	$1 95	$0 91	$0 73	$1 22	1.35	915
Sept. 1 to Sept. 10, .	2 38	1 16	93	1 45	1.36	888
Sept. 15 to Sept. 27, .	3 04	1 72	1 38	1 66	1.41	896
Oct. 4 to Oct. 22, .	4 30	2 15	1 72	2 58	1.62	976
Total, . .	$11 67	$5 94	$4 76	$6 91	–	–

Elsie.

June 19 to June 27, .	$2 22	$1 01	$0 81	$1 41	1.48	1,150
July 2 to July 15, .	2 94	1 54	1 23	1 71	1.19	1,142
Sept. 1 to Sept. 10, .	2 43	1 18	94	1 49	1.50	1,134
Sept. 15 to Sept. 27, .	3 33	1 89	1 51	1 82	1.52	1,148
Oct. 4 to Oct. 22, .	4 68	2 31	1 85	2 83	1.75	1,210
Total, . .	$15 60	$7 93	$6 34	$9 26	–	–

Juno.

July 2 to July 15, .	$2 83	$1 48	$1 18	$1 65	.80	990
Sept. 1 to Sept. 10, .	2 49	1 20	96	1 53	1.04	1,010
Sept. 15 to Sept. 27, .	3 42	1 95	1 56	1 86	1.11	978
Oct. 4 to Oct. 22, .	4 93	2 42	1 94	2 99	1.29	1,046
Total, . .	$13 67	$7 05	$5 64	$8 03	–	–

Analyses of Milk.

[Per cent.]

Jessie.

1889.	June 25.	July 16.	Sept. 12.	Sept. 24.	Oct. 15.
Solids, ...	14.76	15.03	13.90	15.43	14.74
Fat, ...	5.36	5.32	4.74	5.56	5.33
Solids not fat, . . .	9.41	9.71	9.16	9.87	9.41

Flora.

Solids, ...	15.56	13.33	12.46	14.11	13.35
Fat, ...	4.78	3.76	3.33	4.36	4.10
Solids not fat, . . .	10.78	9.57	9.13	9.75	9 25

Eva.

Solids, ...	14.79	15.06	14.07	16.25	16.25
Fat, ...	4.89	5.13	4.65	6.00	6.10
Solids not fat, . . .	9.90	9.93	9.42	10.25	10.15

Annie.

Solids, ...	14.18	14.20	14.12	15.71	15.68
Fat, ...	4.39	4.65	4.55	5.12	5.18
Solids not fat, . . .	9.79	9.55	9.57	10.59	10.50

Elsie.

Solids, ...	12.70	13.05	12.29	13.33	12.82
Fat, ...	3.45	3.52	3.42	5.17	3.55
Solids not fat, . . .	9.25	9.53	8.87	8.16	9.27

Juno.

Solids, ...	–	12.53	11.35	12.87	13.22
Fat, ...	–	2.93	2.78	4.11	4.03
Solids not fat, . . .	–	9.60	8.57	8.76	9.19

COMPOSITION OF FODDER ARTICLES FED DURING THIS EXPERIMENT.

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.29	265.80	–	–	1 : 9.09
Dry matter, ...	86.71	1,734.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.67	33.40	–	–	
" cellulose, . . .	1.69	33.80	11.49	34	
" fat, ...	4.04	80.80	61.41	76	
" protein (nitrogenous matter), . .	11.00	220.00	187.00	85	
Non-nitrogenous extract matter, ...	81.60	1,632.00	1,534.08	94	
	100.00	2,000.00	1,793.98	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.92	218.40	–	–	1 : 3.99
Dry matter, ...	89.08	1,781.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.00	140.00	–	–	
" cellulose, . . .	11.52	230.40	46.08	20	
" fat, ...	5.43	108.60	86.88	80	
" protein (nitrogenous matter), . .	17.17	343.40	302.19	88	
Non-nitrogenous extract matter, ...	58.88	1,177.60	942.08	80	
	100.00	2,000.00	1,377.23	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.19	203.80	–	–	1 : 2.86
Dry matter,	89.81	1,796.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.57	11.40	–	–	
" cellulose,	.56	11.20	3.81	34	
" fat,	6.40	128.00	97.28	76	
" protein (nitrogenous matter),	29.45	589.00	500.65	85	
Non-nitrogenous extract matter,	63.02	1,260.40	1,184.78	94	
	100.00	2,000.00	1,786.52	–	

Hay (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.48	189.60	–	–	1 : 8.99
Dry matter,	90.50	1,810.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.12	142.40	–	–	
" cellulose,	33.22	664.40	385.35	58	
" fat,	2.30	46.00	21.16	46	
" protein (nitrogenous matter),	10.09	201.80	115.03	57	
Non-nitrogenous extract matter,	47.27	945.40	595.60	63	
	100.00	2,000.00	1,117.14	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Vetch and Oats.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	78.26	1,565.20	–	–	1 : 11.26
Dry matter,	21.74	434.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	4.53	90.60	–	–	
" cellulose,	36.22	724.40	–	–	
" fat,	2.53	50.60	25.30	50	
" protein (nitrogenous matter),	7.72	154.40	92.64	60	
Non-nitrogenous extract matter,	49.00	980.00	980.00	100	
	100.00	2,000.00	1,097.94	–	

Cow-pea.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.07	1,661.40	–	–	1 : 7.46
Dry matter,	16.93	338.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	21.87	437.40	205.58	47	
" fat,	2.99	59.80	35.28	59	
" protein (nitrogenous matter),	11.24	224.80	134.88	60	
Non-nitrogenous extract matter,	56.55	1,131.00	712.53	69	
	100.00	2,000.00	1,088.27	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Concluded.*

Serradella.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.65	1,673 00	–	–	1 : 4.27
Dry matter,	16.35	327.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8.94	178.80	–	–	
" cellulose,	25.92	518.40	–	–	
" fat,	2.38	47.60	28.56	60	
" protein (nitrogenous matter),	17.97	359.40	226.42	63	
Non-nitrogenous extract matter,	44.79	895.80	895.80	100	
	100.00	2,000.00	1,150.78	–	

Vetch and Oats. (*1889.*)

[Left uneaten by the cows during experiment.]

	Per Cent.
Moisture at 100° C.,	4.94
Dry matter,	95.06
	100.00
Analysis of Dry Matter.	
Crude ash,	4.61
" cellulose,	36.72
" fat,	1.79
" protein (nitrogenous matter),	10.52
Non-nitrogenous extract matter,	46.36
	100.00

III. Record of Twelve Cows which served at the Station for Experiments to ascertain the Cost of Feed for the Production of Milk.

When entering at this station upon the task of ascertaining the cost of feed for the production of milk (1884), it was decided to begin the inquiry with cows of moderate milking qualities. Grades of all kinds of breeds were to serve for that purpose. A selection from that class of cows, at the outset of our observation, promised to prove of a special interest, not only on account of their large representation in our dairy stock, but also for the particular chance which our final results would offer to draw more directly the line where milk production ceases to be a profitable business. The material for the subsequent report has been carefully collected during a period of several years. The results, it is true, are obtained under somewhat exceptional circumstances; yet their detailed description cannot fail to show more clearly the financial relation of milk production to a system of a mixed farm management.

The cows which served in our trials were in every instance secured a few days after calving. They were sold to the butcher usually when their daily yield of milk fell below from five to six quarts, to make room for a new-milch cow. The cost of the different animals varied from fifty-five to seventy-two dollars each; they sold at the close of their trial for from twenty-five to thirty-seven dollars each.

The management of the entire experiment was conducted with a view to promote the general health of the animals on trial. Two cows had lost in weight during the experiment, and ten had gained more or less. The change from one diet to another was as a rule a gradual one.

The temporary change in the composition of the daily diet was mainly confined to the coarser and bulky fodder ingredients. English hay, dry fodder corn, corn stover, corn ensilage and roots, besides some small quantity of various dried fodder crops, incidental to some field experiments with forage crops, were fed during the latter part of autumn, the winter and the spring; while several green crops, as oats or barley and vetch, serradella and cow-peas, were substituted during the summer and part of the fall season. The several previously named fodder crops served in the majority of

cases either in part or in the whole as substitutes for English hay.

The daily rations of grain fed consisted throughout the entire period, in all cases alike, substantially of the same materials; namely, corn meal or corn and cob meal, and wheat bran, which were supplemented, in the majority of instances, more or less by gluten meal, to secure as far as practicable the desired comparative nutritive character of the diet. The daily diet per head consisted of from eighteen to twenty or more pounds of hay, or its equivalent in part or in the whole of dry vegetable matter of the above-mentioned bulky fodder articles, and from six and one-half to nine and three-quarters pounds of grain feed, usually composed of corn meal or corn and cob meal, and wheat bran, with or without gluten meal (three and one-fourth pounds).

The ruling local average market price of each fodder article has been used for the determination of the cost of feed consumed. The estimates of fertilizing constituents contained in the various fodder articles used are based on our own analysis, and on their local market price during the past year. Twenty per cent. loss of the fertilizing constituents contained in the feed has been allowed for the amount sold with the milk.

The period of observation varied, in case of different cows, from 261 to 747 days; the average daily yield of milk per head for the whole period of observation varied from 7.7 to 12.4 quarts.

Three cents per quart of milk produced has been adopted as the average price realized for the entire year, in case of milk contracts in our vicinity.

The essential details of our observations are subsequently recorded in tabular form, under the following headings: —

1. History of cows.
2. Statement of the amount of each kind of fodder ingredients consumed by each animal, with total cost of feed for period of observation.
3. Local market value per ton of each fodder article used.
4. Value of essential fertilizing constituents contained in the various articles of fodder consumed.
5. Summary of financial record of cows.
6. Some conclusions suggested by the financial record.

1. *History of Cows on Trial.*

NAME AND AGE OF COW.		Breed (Grades).	Number of Calves.	Last Calf.	Date of Arrival.	Date of Departure.	Number of Days milked.	Total Yield of Milk during Observation (Quarts).	Average Yield of Milk per Day at Beginning of Observation (Quarts).	Average Yield of Milk per Day during Ninth Month (Quarts).	Average Yield of Milk per Day at Close of Observation (Quarts).	Average Yield of Milk per Day during Entire Observation (Quarts).	Total Yield of Milk for First 300 Days of Observation (Quarts).	Average Yield of Milk per Day for First 300 Days of Observation (Quarts).	Live Weight of Animal at Beginning of Observation (Pounds).	Live Weight of Animal at Close of Observation (Pounds).
1. Bessie,	8 yrs.,	Jersey, .	4	Oct. 17, 1884,	Oct. 23, 1884,	Oct. 31, 1885,	374	3,721.3	16.5	9.2	6.9	10.0	3,213.3	10.7	809	833
2. Lady Horace,	8 yrs.,	Ayrshire,	4	Oct. 15, 1884,	Oct. 23, 1884,	Oct. 31, 1885,	374	4,065.5	16.7	9.8	7.9	10.9	3,480.3	11.6	931	970
3. Daisy (1),	7 yrs.,	Ayrshire,	3	Nov. 10, 1885,	Nov. 17, 1885,	Sept. 16, 1886,	301	3,613.5	15.3	7.9	10.5	11.9	3,571.5	11.9	911	838
4. Mollie,	7 yrs.,	Ayrshire,	3	Nov. 6, 1885,	Nov. 17, 1885,	Sept. 19, 1886,	307	3,121.6	12.1	8.1	8.5	10.2	3,063.5	10.2	801	880
5. Susie,	5 yrs.,	Ayrshire,	2	July 14, 1886,	July 30, 1886,	May 3, 1887,	278	3,446.5	15.6	9.8	9.8	12.4	3,663.3*	12.2	849	1,025
6. Meg,	6 yrs.,	Devon, .	3	Aug. 2, 1886,	Aug. 16, 1886,	May 3, 1887,	261	3,233.8	17.2	10.8	10.9	12.4	3,623.8*	12.1	1,018	1,162
7. Lizzie,	5 yrs.,	Native, .	2	Feb. 1, 1887,	Feb. 5, 1887,	June 22, 1888,	603	6,023.3	19.7	9.2	8.3	12.0	4,176.8	13.9	995	1,102
8. Ida,	7 yrs.,	Durham,	4	Feb. 3, 1887,	Feb. 7, 1887,	Jan. 3, 1887,	331	2,527.8	16.0	3.9	1.3	7.7	2,496.0	8.3	978	1,000
9. Minnie,	7 yrs.,	Ayrshire,	4	May 3, 1887,	May 17, 1887,	Dec. 22, 1888,	684	6,770.0	17.6	12.8	5.1	11.6	3,996.3	13.3	885	1,011
10. Daisy (2),	5 yrs.,	Durham,	3	Jan. 6, 1888,	Jan. 16, 1888,	Jan. 19, 1889,	369	4,557.8	18.9	10.2	6.3	12.4	4,106.5	13.7	1,132	1,185
11. May,	8 yrs.,	Jersey, .	3	June 6, 1887,	June 13, 1887,	June 28, 1889,	747	7,813.6	14.3	12.0	9.6	10.5	3,419.0	11.4	817	990
12. Molla,	10 yrs.,	Dutch, .	7	Aug. 5, 1887,	Aug. 11, 1887,	Mar. 1, 1889,	569	6,366.6	14.3	11.8	7.1	11.2	3,866.5	12.9	961	1,115
Averages,	. .	. . .		. . .	. . .	. . .	417	4,608.7	16.2	9.6	7.7	11.1	3,556.1	11.9	932	1,008

* Estimated.

2. *Amount of Each of the Various Kinds of Feed consumed (in Pounds) by the Cows on Trial.*

	1. Bessie.	2. Lady Horace.	3. Daisy (1).	4. Mollie.	5. Susie.	6. Meg.	7. Lizzie.	8. Ida.	9. Minnie.	10. Daisy (2).	11. May.	12. Mella.
Corn meal,	941.25	941.25	877.50	890.50	900.25	848.50	1,126.50	1,075.75	1,343.50	612.25	1,846.00	1,292.00
Corn and cob meal,	–	–	–	–	–	–	508.25	–	557.25	557.25	557.25	557 25
Wheat bran,	931.25	931.25	939.25	955.50	825.50	776.75	1,530.75	975.00	1,868.75	1,199.25	2,403.25	1,849 25
Rye middlings,	–	–	–	–	74 75	71.50	156.00	156 00	65.00	–	–	–
Gluten meal,	74.75	74.75	–	–	520.00	523.25	771.50	304.00	1,083.00	1,134 50	1,685.25	1,312.50
Hay,	4,228.75	5,122.00	2,962.00	2,780.00	4,073.50	3,311.50	7,418 75	4,925.25	6,886.00	4,351.50	8,086.50	6,656.50
Rowen,	–	–	–	–	–	500.00	1,833.25	1,268.00	1,836.00	528 00	2,464.00	1,843.00
Corn fodder (dry),	324.75	408.00	435.00	473.00	399 50	313.00	713.25	–	824 50	1,600.00	1,059.00	925 00
Corn stover (dry),	–	–	–	–	94.00	90.50	112.00	90.50	86.25	368.00	304.00	242.00
Corn ensilage,	2,098.00	2,188 00	2,990 00	2,959.00	930 00	826.50	878.00	–	1,017 25	1,539.25	2,415.00	2,150.00
Millet (dry),	156.00	119 00	37.00	32.00	–	–	–	–	–	–	–	–
Vetch and lucerne (dry),	72.00	98 00	–	–	–	–	–	–	–	–	–	–
Lucerne and clover (dry),	24.00	30.00	–	–	–	–	–	–	–	–	–	–
Oats (dry),	–	–	308.00	528.00	–	–	–	–	–	–	–	–
Oats (green),	–	–	585.00	585.00	70.00	140.00	–	–	–	–	–	–
Vetch and oats (green),	–	–	–	–	–	–	–	–	2,059.50	1,051.00	2,206.00	998 00
Vetch (green),	–	–	319.00	251.00	40.00	45 00	–	–	–	–	–	–
Serradella (green),	–	–	580.00	725.00	320.00	–	–	–	2,408.50	–	2,374.00	–
Cow-pea (green),	–	–	656.00	676.00	700.00	711.00	–	–	3,109.00	821.00	3,110.00	783.00
Barley and beans (green),	215.00	245.00	–	–	–	–	–	–	–	–	–	–
Potatoes,	–	–	–	–	–	–	–	1,190 00	–	–	–	–
Carrots,	–	–	–	–	–	–	–	–	–	859.00	916.00	918.00
Roots (sugar beets),	–	–	1,592.00	1,592.00	1,041.50	1,052.00	519.50	567.50	91.00	92.00	92.00	92.00
Total cost of feed,	$59 00	$65 65	$56 46	$56 04	$63 25	$59 50	$118 96	$80 08	$135 05	$88 33	$174 00	$130 51

3. *Local Market Value per Ton of the Various Articles of Fodder used.*

Corn meal,	$23 00
Corn and cob meal,	20 70
Wheat bran,	21 50
Rye middlings,	21 50
Gluten meal,	23 00

Hay,	$15 00	Vetch and oats (green),	$2 75
Rowen,	15 00	Vetch (green),	3 50
Corn fodder,	5 00	Serradella (green),	3 16
Corn stover,	5 00	Cow-pea (green),	3 14
Corn ensilage,	2 25	Barley and horse bean (green),	3 00
Millet (dry),	12 00	Potatoes,	6 67
Lucerne and vetch (dry),	12 00	Carrots,	7 00
Lucerne and clover (dry),	12 00	Sugar beets,	5 00
Oats (dry),	12 00		
Oats (green),	3 60		

4. *Valuation of the Essential Fertilizing Constituents contained in the Various Articles of Fodder used.*

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

[Per cent.]

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Corn meal,	1.86	0.77	0.45	$7 44
Corn and cob meal,	1.46	0.603	0.441	5 91
Wheat bran,	2 82	3.05	1.49	14 24
Rye middlings,	1.84	1.26	0.81	8 27
Gluten meal,	5.22	0.40	0.05	17 75
Hay,	1.25	0.464	2.085	6 46
Rowen,	1.93	0.364	2.86	9 24
Corn fodder (dry),	1.37	0.368	0.355	5 26
Corn stover (dry),	0.78	0.09	0.599	3 19
Corn ensilage,	0.36	0.14	0.33	1 64
Millet (dry),	1.106	0.38	2.49	6 23
Lucerne and vetch (dry),	2.02	0.70	2.273	9 44
Lucerne and clover (dry),	2.06	0.623	1.805	9 08
Oats (dry),	1.47	0.51	2.41	7 51
Oats (green),	0.33	0.155	0.68	1 85
Vetch and oats (green),	0.23	0 09	0.79	1 54
Vetch (green),	0.49	0.20	0.66	2 42
Serradella (green),	0.411	0.14	0.423	1 89
Cow-pea (green),	0.561	0.098	0.306	2 23
Barley and beans (green),	0.50	0.20	0.40	2 23
Potatoes,	0.476	0.18	0.56	2 18
Carrots,	0.14	0.10	0.54	1 04
Sugar beets,	0.29	0.03	0.18	1 15

5. *Summary of Financial Record of Cows.*

NAME OF COW.	Total Value of Milk at Three Cents per Quart.	Total Cost of Feed consumed.	Manurial Value of Food, less Twenty Per Cent. taken by Milk.	Net Cost of Feed.	Original Cost of Cow.	Selling Price of Cow.	Total Value received above Net Cost of Feed and of Cow.	Value received in Form of Manure.	Value received in Form of Cash.	Total Value received per Day.
										Cents.
1. Bessie,	$111 73	$59 00	$22 27	$36 73	$65 00	$25 00	$35 00	$22 27	$12 73	9.36
2. Lady Horace,	121 90	65 65	24 69	40 96	65 00	26 50	42 44	24 69	17 75	11.35
3. Daisy (1),	108 41	56 46	21 95	34 51	60 00	25 00	38 90	21 95	16 95	12.80
4. Mollie,	93 74	56 04	22 24	33 80	60 00	25 00	24 94	22 24	2 70	8.12
5. Susie,	103 40	63 25	24 81	38 44	60 00	37 40	42 36	24 81	17 55	15.24
6. Meg,	97 01	59 50	23 84	35 67	60 00	37 54	38 88	23 83	15 05	14.90
7. Lizzie,	180 70	118 96	47 64	71 32	65 00	28 00	72 38	47 64	24 74	14.39
8. Ida,	75 83	80 08	30 28	49 80	55 00	25 00	—3 97	30 28	—34 25	—1.20
9. Minnie,	203 37	135 05	56 93	78 12	60 00	28 00	93 25	56 93	36 32	15.97
10. Daisy (2),	136 33	88 33	37 94	50 39	72 50	35 00	48 44	37 94	10 50	13.13
11. May,	235 31	174 60	73 35	101 25	60 00	30 00	104 06	73 35	30 71	13.93
12. Melia,	191 00	130 51	54 50	76 01	65 00	30 00	79 99	54 50	25 49	14.06
Averages,	$138 23	$90 62	$36 70	$53 92	$62 29	$29 38	$51 40	$36 70	$14 70	11.83

Average cost of cow (twelve),	$62 29
Average selling price of cow,	29 38
Average of total cost of feed per day,	21.54 cents.
Average product per day for entire observation, per head,	11.06 quarts.
Average of net cost of feed per day,	12.94 cents.
Average of value received above net cost of feed and of cow, per day,	12.33 cents.
Average of value received in form of manure, per day,	8.81 cents.
Average of value received in form of cash, per day,	3.52 cents.

The average yield of milk at the end of the ninth month, since day of calving, was sixty-one per cent. of original yield. The shrinkage in the temporary market value of cow varies from five to eleven and four-tenths cents per day, and averages eight cents per head in our case.

The net cost of the feed consumed is obtained by deducting eighty per cent. of the current commercial value of the essential fertilizing constituents contained in the feed from the market cost of the feed. See —

Bessie.

Market value of feed consumed,	$59 00
Value of manure obtainable,	22 27
Net cost of feed,	$36 73

The total value obtained for the feed consumed is ascertained by adding the value secured from the sale of milk produced to the commercial value represented in the manure obtainable. See —

Bessie.

Value of milk sold,	$111 73
Value of eighty per cent. of the manurial substances in the feed,	22 27
Total value obtained from feed consumed,	$134 00

The total value secured from any individual cow, after net cost of feed and of cow has been accounted for, is represented by subtracting the sum resulting from the addition of the difference between the original cost of the cow and its selling price, and of the total cost of feed consumed, from the total value obtained in form of milk and manurial refuse. See —

Bessie.

Original cost of cow,	$65 00
Selling price of cow,	25 00
Difference,	$40 00
Loss on cow,	$40 00
Total cost of feed,	59 00
	$99 00
Total value obtained from feed,	$134 00
Total cost of feed and loss on cow,	99 00
Net return for feed,	$35 00

It seems to be scarcely necessary to add that the above estimates refer only to the cost of feed and of the cow, and do not include cost of labor, housing, interest and risk of life of animal, etc.

6. *Some Conclusions suggested by the Preceding Financial Record.*

1. The total value received above net cost of feed and of cow does in no instance exceed 15.97 cents per day; its average in eleven cases is 13.02 cents. There is an actual loss of 1.2 cents per day in one case (No. 8), where the average daily yield of milk for the entire period of observation (331 days) is as low as 7.7 quarts.

2. The total value received above net cost of feed and of cow consists in every instance in a controlling degree on the manure obtainable. In No. 8 it prevents a serious loss, while in No. 4 it represents practically the entire gain; in some instances it amounts to from three-fourths to two-thirds (Nos. 12 and 3), and in none as low as one-half of the total value secured.

3. As the value of the manure depends in a controlling degree on the amount of fertilizing constituents contained in the feed, it becomes apparent that this point ought to be seriously considered when selecting suitable fodder articles for a remunerative daily diet of dairy cows. The table containing the valuation of the essential fertilizing constituents of the fodder articles used in our experiments is very sug-

gestive in this connection, when compared with the preceding statements of respective market prices of the latter.

4. Recognizing the correctness of the preceding conclusion, it is evident that the most serious attention ought to be bestowed on collecting and preserving the manurial refuse obtained in connection with the production of milk; for it depends largely on a judicious management of that matter, how much of the stated manurial value will be actually secured. The liability of a loss in the manurial value of the refuse matter renders it advisable, for financial reasons, not to depend on too close a margin of cash returns.

5. Although it will be conceded that the dairy cow, aside from the special service, is a most important factor in mixed farm management, as far as an economical disposition of home-raised fodder crops and a liberal production of home-made manure are concerned, yet, when reduced to a mere manure-producing medium, this value may be well questioned from a financial stand-point.

6. A cow whose total milk record averages not more than from seven to eight quarts per day, judging from our own conditions, promises to prove a better investment when prepared for the meat market than when constituting a liberal proportion of the stock kept for supplying the general milk market at stated prices.

IV. Creamery Record of the Station during the Years 1887, 1888 and 1889; and Some Observations made during Visits to the Patrons of Two Creameries in Our Vicinity.

In preceding pages has been stated the financial record of twelve cows, grades which had served during past years for feeding experiments at the station. It was stated in that connection that the primary object at that time was to test the comparative merits of corn fodder, corn stover, corn ensilage and root crops, in the whole or in part, as circumstances advised, as substitutes for a good meadow hay, as far as quantity, quality and cost of production of milk are concerned. The cows selected for that investigation, were, for stated reasons, of moderate milking qualities. Our financial records, although obtained under somewhat exceptional circumstances, are published with full recognition of that point, considering them not without some interest to others studying the financial side of the dairy industry in its varying aspects.

The subsequent communication contains a discussion of our creamery record, which covers, to a considerable extent, the time when the above-mentioned milk record was obtained. The milk was weighed at the station, and the cream secured and measured by means of a Cooley creamery apparatus. A copy of the daily record was kept in our dairy room by the agent of the creamery. Two quarts of milk used daily for family purposes are accounted for in our calculations of total results. Analyses of milk were made where a change of daily diet rendered it advisable.

The cost of feed consumed is based on the same market price of the various ingredients as was adopted in the preceding milk record. The same is true in regard to the valuation of the whole milk, — three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are also based upon those given in connection with the preceding milk record.

The value of cream is that granted us from month to month by our local creamery association. The station has

no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved; for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock, and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.

1. Statement of Articles of Fodder used during 1887, 1888 and 1889 (in Pounds).

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Potatoes.	Carrots.	Sugar Beets.
1887.																
January, .	299.0	–	299.0	–	299.0	366.0	–	184.5	–	2,590.0	–	–	–	–	–	–
February, .	523.5	–	523.5	–	409.5	1,630.0	–	–	467.5	–	–	–	–	–	–	4,255.0
March, .	585.0	–	585.0	–	585.0	390.0	2,975.0	–	115.0	–	–	–	–	–	–	663.5
April, . .	585.0	–	481.0	101.0	585.0	3,550.0	–	–	–	–	–	–	–	–	–	–
May, . .	466.0	–	81.5	637.0	130.0	2,860 0	–	–	–	–	–	–	–	–	–	–
June, . .	549.5	–	549.0	–	–	3,380.0	–	–	–	–	–	–	–	–	–	–
July, . .	598.0	–	552.5	–	–	2,521.5	–	–	–	–	3,415.0	–	–	–	–	–
August, .	572.0	–	572.0	–	–	2,494.0	–	–	–	–	–	–	6,150.0	–	–	–
September, .	585.0	–	585.0	–	–	2,660.5	–	–	–	–	–	7,185.0	735.0	–	–	–
October, .	604.5	–	604.5	–	–	4,368.5	–	–	–	–	–	–	–	–	–	–
November, .	585.0	–	585.0	–	–	212.5	4,194.5	–	–	–	–	–	–	570.0	–	–
December, .	590.0	–	589.5	–	24.0	1,183.0	3,023.5	–	–	–	–	–	–	620.0	–	–
1888.																
January, .	280.0	282.0	562.5	–	522.5	3,378.0	–	–	–	–	–	–	–	–	–	–
February, .	–	565.5	565.5	–	565.5	1,155.0	–	2,064.0	–	225.0	–	–	–	–	–	–
March, .	–	604.5	604.5	–	604.5	1,307.5	–	79.5	–	5,094.0	–	–	–	–	–	–
April, . .	–	585.0	585 0	–	585.0	1,050.0	–	1,319.5	–	1,303.5	–	–	–	–	–	–
May, . .	–	604.5	604.5	–	510.0	3,600.0	–	27.0	–	–	–	–	–	–	–	551.0

1. Statement of Articles of Fodder used during 1887, 1888 and 1889 (in Pounds)—*Concluded.*

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Potatoes.	Carrots.	Sugar Beets.
June, . .	–	585.0	585.0	–	291.0	3,600.0	–	–	–	–	–	–	–	–	–	–
July, . .	413.0	117.0	530.0	–	530.0	2,054.0	–	–	–	–	4,730.5	–	–	–	–	–
August, .	504.0	–	504.0	–	504.0	620 0	2,584.0	–	–	–	–	–	–	–	–	–
September, .	510.0	–	510.0	–	510.0	2,148.5	–	–	–	–	–	–	3,970.0	–	–	–
October, .	575.5	–	575.5	–	575.5	3,431.0	–	–	–	–	–	–	–	–	–	–
November, .	585.0	–	585.0	–	585.0	1,845.0	–	1,348.5	–	–	–	–	–	–	–	–
December, .	588.5	–	588.5	–	588.5	223.0	–	1,183.0	1,488.5	–	–	–	–	–	461.0	–
1889.																
January, .	608.75	–	604.75	–	581.75	1,772.00	–	–	–	1,475.00	–	–	–	–	4,868.00	–
February, .	552.50	–	552.50	–	552.50	1,268.50	–	–	–	5,069.50	–	–	–	–	–	–
March, .	591.50	–	591.50	–	591.50	2,396.00	–	–	–	–	–	–	–	–	–	4,081.00
April, . .	572.00	–	562.25	–	563.88	2,395.50	838.00	–	–	–	–	–	–	–	–	1,125.00
May, . .	604.50	–	583.38	–	604.50	900.50	2,713.50	–	–	–	–	–	–	–	–	–
June, . .	585.00	–	585.00	–	585.00	1,858.50	1,295.50	–	–	–	582.75	–	–	–	–	–
July, . .	604.50	–	604.50	–	604.50	431.00	1,871.00	–	–	–	4,308.75	–	–	–	–	–
August, .	402.00	–	402.00	–	402.00	180.00	3,755.25	–	–	–	–	–	1,512.00	–	–	–
September, .	585.00	–	585.00	–	585.00	1,002.00	–	–	–	–	–	8,182.50	4,983.00	–	–	–
October, .	604.50	–	604.50	–	604.50	3,574.50	–	–	–	–	–	–	–	–	–	–

2. (*A*) Record of Average Quality of Milk and of Fodder Rations (1887).

1887.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds). Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January,	12.38	3.45	2.17	1:6.20	3.25	–	3.25	–	3.25	5.00	–	–	–	29.00	–	–	–	–
February,	13.13	4.07	2.02	1:5.90	3.25	–	3.25	–	3.25	10.00	–	–	–	–	–	–	–	35.00
March,	13.13	3.97	2.19	1:6.20	3.25	–	3.25	–	3.25	–	20.00	–	–	–	–	–	–	–
April,	12.84	3.73	2.42	1:6.10	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
May, }	13.31	4.13	1.80	1:9.15	3.25	–	–	6.25	–	20.00	–	–	–	–	–	–	–	–
June, }			1.82	1:8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
July,	13.11	4.28	1.97	1:8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
				1:6.94	3.25	–	3.25	–	–	5.00	–	–	–	–	62.00	–	–	–
August,	12.70	3.78	1.73	1:8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
				1:5.19	3.25	–	3.25	–	–	5.00	–	–	–	–	–	–	98.00	–
September,	13.04	4.04	1.74	1:5.40	3.25	–	3.25	–	–	5.00	–	–	–	–	–	98.00	–	–
				1:8.75	3.25	–	3.25	–	–	24.00	–	–	–	–	–	–	–	–
October,	13.54	4.50	1.63	1:8.75	3.25	–	3.25	–	–	24.00	–	–	–	–	–	–	–	–
November,	–	–	1.97	1:5.99	3.25	–	3.25	–	–	–	27.00	–	–	–	–	–	–	–
December,	13.16	4.24	1.67	1:5.99	3.25	–	3.25	–	–	–	27.00	–	–	–	–	–	–	–
Averages,	13.04	4.00	1.93															

2. (*B*) RECORD OF AVERAGE QUALITY OF MILK AND OF FODDER RATIONS (1888).

1888.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	FEED CONSUMED PER DAY (IN POUNDS). Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January,	13.18	4.08	1.58	1 : 6.1	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
February,	13.98	3.67	1.75	1 : 6.2	–	3.25	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
March,	13.77	3.79	1.71	1 : 5.5	–	3.25	3.25	–	3.25	7.50	–	–	–	30.00	–	–	–	–
April,	13.83	4.00	1.73	1 : 5.5	–	3.25	3.25	–	3 25	7.50	–	–	–	30.00	–	–	–	–
				1 : 6.2	–	3.25	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
May,	–	–	1.67	1 : 5.9	–	3 25	3.25	–	3.25	20.00	–	–	–	–	–	–	–	–
June,	–	–	1.76	1 : 7.3	–	3 25	3.25	–	1.50	20.00	–	–	–	–	–	–	–	–
July,	13.04	3.14	1.93	1 : 5.5	3.25	–	3.25	–	3.25	5.00	–	–	–	–	60.00	–	–	–
August,	12.87	3.86	1.83	1 : 5.9	3.25	–	3.25	–	3.25	–	20.00	–	–	–	–	–	–	–
September,	13.26	3.79	1.85	1 : 6.1	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
				1 : 4.5	3.25	–	3.25	–	3.25	5.00	–	–	–	–	–	–	78.00	–
October,	–	–	1.72	1 : 6.3	3.25	–	2.25	–	3.25	20.00	–	–	–	–	–	–	–	–
November,	14.39	4.55	1.63	1 : 6.3	3.25	–	3.25	–	3.25	20.00	–	–	–	–	–	–	–	–
				1 : 6.2	3.25	–	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
December,	14.78	4.86	1.43	1 : 6.2	3.25	–	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
				1 : 6.7	3.25	–	3.25	–	3.25	–	–	–	22.00	–	–	–	–	–
Averages,	13.68	3.97	1.72															

2. (C) RECORD OF AVERAGE QUALITY OF MILK AND OF FODDER RATIONS (1889).

1889.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	FEED CONSUMED PER DAY (IN POUNDS). Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Carrots.	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January,	14.49	3.90	1.76	1:6.21	3.25	–	3.25	–	3.25	10.00	–	–	39.57	–	–	–	–	–
February,	13.93	4.29	1.74	1:6.57	3.25	–	3.25	–	3.25	5.00	–	–	–	36.51	–	–	–	–
March,	14.12	4.36	1.65	1:5.99	3.25	–	3.25	–	3.25	16.40	–	–	–	–	–	–	–	–
				1:6.14	3.25	–	3.25	–	3.25	10.00	–	–	–	–	–	–	–	45.60
April,	14.14	4.56	1.62	1:6.12	3.25	–	3.25	–	3.25	18.38	–	–	–	–	–	–	–	–
May,	14.03	4.34	1.60	1:5.21	3.25	–	3.25	–	3.25	–	19.53	–	–	–	–	–	–	–
June,	14.42	4.58	1.62	1:5.30	3.25	–	3.25	–	3.25	–	20.60	–	–	–	–	–	–	–
				1:6.18	3.25	–	3.25	–	3.25	18.00	–	–	–	–	–	–	–	–
July,	13.92	4.30	1.72	1:6.38	3.25	–	3.25	–	3.25	5.00	–	–	–	46.50	–	–	–	–
				1:5.30	3.25	–	3.25	–	3.25	–	20.60	–	–	–	–	–	–	–
August,	13.85	4.21	1.70	1:5.62	2.00	–	2.00	–	2.00	–	24.10	–	–	–	–	–	–	–
September,	13.82	4.48	1.65	1:6.05	3.25	–	3.25	–	3.25	5.00	–	–	–	–	–	76.23	–	–
				1:4.70	3.25	–	3.25	–	3.25	5.00	–	–	–	–	78.23	–	–	–
October,	14.34	4.72	1.53	1:6.26	3.25	–	3.25	–	3.25	19.30	–	–	–	–	–	–	–	–
Averages,	14.11	4.37	1.66															

3. Value of Cream produced at Creamery Basis of Valuation.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1887.					
January,	$16 21	$9 69	$0 27	$6 79	$17 24
February,	40 39	17 76	69	23 32	38 85
March,	46 93	27 10	71	20 54	40 20
April,	46 34	22 68	57	24 23	31 14
May,	36 02	15 34	64	21 32	32 47
June,	37 57	16 87	66	21 36	30 03
July,	36 42	16 93	59	20 08	27 69
August,	41 09	14 94	68	26 83	35 91
September,	45 48	22 54	69	23 63	36 30
October,	46 21	20 66	64	26 19	36 30
November,	47 97	27 02	52	21 47	29 48
December,	47 01	25 08	60	22 53	35 23
Averages,	$40 60	$19 72	$0 61	$21 52	$32 57
1888.					
January,	$43 53	$21 42	$0 76	$22 87	$45 76
February,	32 51	20 05	73	13 19	44 00
March,	35 44	20 05	69	16 08	40 91
April,	31 71	19 19	65	13 17	35 99
May,	47 06	22 63	65	25 08	34 23
June,	42 69	20 11	58	23 16	28 67
July,	39 66	20 63	63	19 66	30 94
August,	40 66	23 64	61	17 63	32 48
September,	39 57	21 42	57	18 72	32 02
October,	45 15	22 44	62	23 33	35 92
November,	36 95	21 03	64	16 56	37 67
December,	29 82	17 97	59	12 44	34 67
Averages,	$38 73	$20 58	$0 64	$18 49	$36 11
1889.					
January,	$52 21	$21 23	$0 66	$31 64	$40 60
February,	33 86	19 15	63	15 34	36 19
March,	48 14	21 77	75	27 11	42 48
April,	46 17	23 40	78	23 55	42 84
May,	47 28	27 23	83	20 88	39 28
June,	44 21	23 98	72	20 95	33 06
July,	43 63	25 28	76	19 11	34 92
August,	45 44	27 54	76	18 66	36 33
September,	48 01	28 08	73	20 66	38 25
October,	37 21	23 47	71	14 45	39 06
Averages,	$44 62	$24 11	$0 73	$21 24	$38 31

4. Cost of Skim-milk at the Selling Price of Three Cents Per Quart for Whole Milk.

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1887.								Cents.	
January,	976.2	445	130.9	845.3	3.88	1.76	$17 24	1.43	$12 05
February,	2,093.1	1,036	304.7	1,788.4	3.75	1.86	38 85	1.34	23 94
March,	2,352.7	1,072	315.3	2,037.4	3.75	1.71	40 20	1.43	30 38
April,	2,083.4	859	252.6	1,830.8	3.63	1.50	31 14	1.71	31 36
May,	1,729.0	962	282.9	1,446.1	3.38	1.88	32 47	1.34	19 40
June,	1,818.7	1,001	294.4	1,524.3	3.00	1.65	30 03	1.61	24 53
July,	1,749.7	886	260.6	1,489.1	3.13	1.58	27 69	1.67	24 80
August,	1,772.6	1,026	301.8	1,470.8	3.50	2.03	35 91	1.17	17 27
September,	1,808.4	1,037	305.0	1,503.4	3.50	2.01	36 30	1.19	17 95
October,	1,574.4	968	284.7	1,289.7	3.75	2.31	36 30	0.85	10 93
November,	1,545.6	786	231.2	1,314.4	3.75	1.91	29 48	1.28	16 89
December,	1,522.3	909	267.3	1,255.0	3.88	2.31	35 23	0.83	10 44
Averages,	1,752.2	916	269.3	1,482.9	3.58	1.89	$32 57	1.32	$19 99
1888.									
January,	1,807.5	1,144	336.5	1,471.0	4.00	2.53	$45 76	0.58	$8 47
February,	1,925 8	1,100	323.5	1,602.3	4.00	2.28	44 00	0.86	13 77
March,	1,794.5	1,049	308.5	1,486.0	3.90	2.28	40 91	0.87	12 93
April,	1,702.5	986	290.0	1,412.5	3.65	2.11	35 99	1.07	15 09
May,	1,638.1	978	287.6	1,350.5	3.50	2.10	34 23	1.10	14 91
June,	1,553.9	882	259.4	1,294.5	3.25	1.85	28 67	1.39	17 95
July,	1,841.5	952	280.0	1,561.5	3.25	1.68	30 94	1.56	24 31
August,	1,696.9	928	272.9	1,424.0	3.50	1.91	32 48	1.29	18 43
September,	1,580.1	854	251.2	1,328.9	3.75	2.03	32 02	1.16	15 38
October,	1,606.8	933	274.4	1,332.4	3.85	2.24	35 92	1.00	12 28
November,	1,576.0	966	284.1	1,291.9	4.00	2.39	37 67	0.74	9 61
December,	1,270.3	889	261.5	1,008.8	4.00	2.73	34 67	0.34	3 44
Averages,	1,666.2	972	285.8	1,380.4	3.72	2.18	$36 11	1.00	$13 88
1889.									
January,	1,791.1	1,015	298.5	1,492.6	4.00	2.27	$40 60	0.88	$13 13
February,	1,680.0	965	283.8	1,396.2	3.75	2.15	36 19	1.02	14 21
March,	1,895.0	1,148	337.6	1,557.4	3.70	2.24	42 48	0.92	14 37
April,	1,931.6	1,190	350.0	1,581.6	3.60	2.22	42 84	0.96	15 11
May,	2,025.2	1,267	372.6	1,652.6	3.10	1.94	39 28	1.30	21 48
June,	1,785.6	1,102	324.1	1,461.5	3.00	1.85	33 06	1.40	20 51
July,	2,001.2	1,164	342.4	1,658.8	3.00	1.74	34 96	1.51	25 12
August,	1,991.9	1,172	344.7	1,647.2	3.10	1.82	36 33	1.42	23 43
September,	1,856 0	1,125	330.9	1,525.1	3.40	2.06	38 25	1.14	17 43
October,	1,665.0	1,085	319.1	1,345 9	3.60	2.35	39 06	0.81	10 89
Averages,	1,862.3	1,123	330.4	1,531.9	3.43	2.06	$38 31	1.14	$17 57

5. Fertilizing Constituents of Cream.

[Average analysis.]

	Per Cent.
Moisture at 100° C.,	75.22
Nitrogen ($16\frac{1}{2}$ cents per pound),	.54
Potassium oxide ($4\frac{1}{4}$ cents per pound),	.123
Phosphoric acid (6 cents per pound),	.168

6. Some Conclusions drawn from the Preceding Records.

1. The relative proportion of digestible nitrogenous and non-nitrogenous constituents consumed differs on the whole in a larger degree during the year 1887 than in 1888. During one-half of the year 1887 it ranged above 1 : 8.5 ; during the year 1888 it reached 1 : 7.3 in only one case, and for six of the remaining months it was below 1 : 6 (nutritive ratio). In 1889 it was in one case only 1 : 6.59, while in all others it resembled quite closely those of the preceding year. The different nutritive ratios averaged, for the year 1887, 1 : 7.08 ; for the year 1888, 1 : 6.00 ; for the year 1889, 1 : 5.80.

2. The amount of fat in the milk varied, during the year 1887, from 3.45 to 4.50 per cent., with an average of 4.00 per cent. ; during the year 1888 it varied from 3.14 to 4.86 per cent., with an average of 3.97 per cent. ; while during the year 1889 it varied from 3.90 to 4.72 per cent., with an average of 4.37 per cent.

3. The quantity of milk, in quarts, required to produce one space of cream, during the year 1887, varied from 2.42 to 1.63, and amounted, on the average, to 1.93 quarts for the entire year ; during the year 1888 it varied from 1.93 to 1.43, averaging for the year 1.72 quarts ; and during the year 1889 it varied from 1.76 to 1.53 quarts, with an average of 1.66 quarts.

4. The value received for one space of cream during the year 1887 varied from 3.00 to 3.88 cents, with an average of 3.58 cents ; during the year 1888 from 3.25 to 4.00 cents were received for each space, with an average of 3.72 cents ; which would equal 12.17 cents per quart of cream for 1887 and 12.65 cents for 1888. During the year 1889 the money value allowed by the creamery for one space of cream varied from 3.00 to 4.00 cents, with an average of 3.43 cents, or 11.66 cents per quart.

5. The total cost of feed consumed for the production of one quart of cream amounted for the year 1887 to 15.09 cents, for the year 1888 to 13.55 cents, and for the year 1889 the same as in 1888.

6. The value of fertilizing constituents which are lost to the farm by the sale of cream produced, amounted, according to the analyses of our cream, during the year 1887 to 3.09 per cent., during 1888 to 3.65 per cent., and in 1889 to 3.03 per cent., of the total fertilizing value of the feed. From these figures it will be seen that in selling the cream from the farm much less fertilizing constituents are lost to the farm than in selling the whole milk. A loss of twenty per cent. of the fertilizing constituents contained in the feed has been allowed in our previous publications, when selling the whole milk. The statement of net cost of feed, as compared with that of its total cost, refers to the original cost of the feed less the value of fertilizing constituents obtainable in manure.

7. The net cost of feed consumed per quart of cream (1 quart = 3.4 spaces) averaged, for the year 1887, 8 cents; for the year 1888, 6.47 cents, and for the year 1889, 6.4 cents. As we obtained 12.17 cents per quart of cream during 1887, 12.65 cents during 1888, and 11.5 cents in 1889, we secured a profit above net cost of feed of 4.17 cents per quart in 1887; in the year 1888, 6.18 cents; and in 1889, 5.1 cents, for the same quantity.

8. We produced, during the year 1887, 1,752.2 quarts of whole milk per month; during the year 1888, 1,662.2 quarts; and in 1889, 1,862.3 quarts. It required, on an average, 6.51 quarts of whole milk to produce one quart of cream during 1887, 5.83 quarts during 1888, and 5.64 quarts during 1889. We secured, on an average per month during 1887, 1,482.9 quarts of skim-milk and 269.3 quarts of cream; in 1888, 1,380.4 quarts of skim-milk and 285.8 quarts of cream; and in 1889, 1,531.9 quarts of skim-milk and 330.4 quarts of cream.

9. Counting the whole milk at three cents per quart, then skim-milk has cost us, on an average, during the year 1887, 1.32 cents per quart; during the year 1888, 1.00 cent per quart; and in 1889, 1.14 cents per quart. The cost of

skim-milk varied considerably during different months of the year, mainly on account of the changes in the valuation of the cream. During 1887, the cost of skim-milk varied from .83 to 1.71 cents per quart; in 1888, from .34 to 1.56 cents per quart; and in 1889, from .81 to 1.51 cents per quart.

The feeding value of skim-milk containing 9.5 per cent. of solids, is stated by good authority to stand in the relation of 3.1 to 4, when compared in that respect with whole milk. In case an average whole milk is charged at three cents per quart, skim-milk would be worth, on the previously stated basis, 2.33 cents. The feeding value of skim-milk, estimated on the customary basis of 4.33 cents per pound of digestible nitrogenous substances and of fat, and .9 cents for non-nitrogenous substances, would amount, per gallon, to 1.91 cents.

We have bought, during the past years, creamery butter-milk containing from 7 to 8 per cent. of solids, at 1.37 cents per gallon. (See third annual report, page 42.) Our own skim-milk, with 9.5 per cent. of solids, would represent, on this basis, a value of 1.75 cents per gallon, or .44 cents per quart.

Some Facts concerning Two Creameries.

It seemed of interest to us to learn from personal observation some facts concerning the supply of cream to some creameries in our vicinity. By the courtesy of the officers in charge of these establishments, Mr. Edward R. Flint, assistant in the chemical department of the station, has been permitted to accompany the collectors of cream at their round trips, and to take notes as directed. He has visited at different times all the patrons of these creameries, in all, 193 farms. Cream and butter have been repeatedly tested. The results of our work in this connection are embodied in a few subsequent pages.

Creamery A.

This creamery receives 350 gallons of cream per day, from 129 farms. This is set for sixteen hours at a temperature of 64 degrees F., together with a small amount of sour cream to hasten the ripening process. The cream is then

churned for one hour at a temperature of 64 degrees F., and washed twice with clear water. It is worked once, at which time it is salted at the rate of one ounce of salt per pound. The product of this creamery is about 4,200 pounds per week; 6.13 spaces of cream are considered to make a pound of butter.

Creamery B.

This creamery receives 200 gallons of cream per day, from 64 farms. This is set in one vat for twenty-four hours, at a temperature of 60 degrees F. It is then churned for one hour at 65 degrees F., and washed twice in the churn with clear water. It is worked twice, 1½ ounces of salt per pound being added when first worked. This creamery produces 1,850 pounds of butter per week. A little less than six spaces are considered to make a pound of butter.

Butter samples from creameries A and B show the following results of analysis: —

Creamery A.

Collected.	Moisture.	Butter Fat.	Casein.	Salt.
1889.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
September 6,	12.35	81.54	.80	5.13
10,	11 73	81.43	.70	6.45
16,	12.68	81.65	.71	4.93
18,	11.02	83.32	.51	3.97
21,	11.04	81.79	.60	4.55
23,	10 54	84.35	.54	4.04
25,	12.31	82.40	.52	5.04
26,	12.95	82 21	.60	4.63
October 28,	12.52	82 62	.58	4.28
29,	12.78	87.37	.55	Trace.
30,	11.48	83.69	.64	4.30
31,	11.76	82.17	.88	4.45
Average,	11.93	82.88	.64	4.31.

Creamery B.

Collected.	Moisture.	Butter Fat.	Casein.	Salt.
1889.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
September 27, . . .	10.77	84.09	.64	5.92
30, . . .	11.00	84.25	.56	5.60
October 1, . . .	9.88	83.15	.56	4.76
3, . . .	7.43	86.64	.58	4.53
17, . . .	9.22	85.00	.75	5.11
18, . . .	9.51	84.10	.62	5.32
21, . . .	11.90	84.00	.89	4.15
22, . . .	10.37	84.01	.63	3.61
November 1, . . .	9.21	86.33	.70	4.12
4, . . .	10.12	86.74	.72	5.90
5, . . .	10.14	83.51	.70	5 63
7, . . .	7.11	89.05	.62	3 96
Average, . . .	9.64	85.07	.66	4.72

Cream samples from creameries A and B show the following results of analysis : —

Creamery A.

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 6, ...	24.34	16.86	7.48
10, ...	23.75	16.69	7.06
16, ...	24.25	17.15	7.10
18, ...	23.68	16.39	7.29
21, ...	23.66	15.86	7.80
23, ...	24.58	18.53	6 05
25, ...	24.91	13.74	11.17
26, ...	23 54	15.72	7.82
October 26, ...	23.38	16.51	6.87
29, ...	25.17	18 70	6.47
30, ...	24.96	17.38	7.58
November 6, ...	24.44	18.23	6.21
8, ...	24.60	16.94	7.66
December 10, ...	23.73	15.95	7.78
13, ...	24.91	16.75	8.16
14, ...	24.04	15.73	8.31
26, ...	24 87	16 24	8.63
27, ...	23 81	15.58	8.23
Average, ...	24.26	16.61	7.65

Creamery B.

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 27,	22.65	15.80	6.85
30,	24.37	16.77	7.60
October 1,	22.89	15.67	7.22
3,	23.24	16.05	7.19
17,	23.58	16.54	7.04
18,	23.50	16.24	7.26
21,	23.91	16.98	6.93
22,	22.82	16.06	6.76
November 1,	22.81	15.26	7.43
4,	23.24	15.81	7.52
5,	23.80	16.28	7.53
7,	24.72	17.40	7.32
December 12,	23.38	15.08	8.30
Average,	23.45	16.13	7.30

Analyses of Cream from the station dairy, from samples collected during the time of collection from the creameries, the grain feed consisting of three and one-quarter pounds corn meal, three and one-quarter pounds bran, and three and one-quarter pounds gluten meal; the coarse feed of five pounds hay, seventy-five pounds serradella (green).

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 6,	28 09	20.33	7.76
11,	24.65	17.91	6.74
17,	25.25	18.95	6.30
18,	27.65	20.42	7.23
21,	27.20	20.51	6.69
24,	27.27	20.16	7.11
25,	26 21	18.32	7.89
26,	26.18	17.13	9.05
Average,	26.56	19.22	7.34

Summary of Butter and Cream Analyses.

Butter.

	Moisture.	Butter Fat.	Casein.	Salt.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Average of Creamery A, .	11.93	82.88	.64	4.31
Average of Creamery B, .	9.64	85.07	.66	4.72

Cream.

	Solids.	Fat.	Solids not Fat.
	Per Cent.	Per Cent.	Per Cent.
Average of Creamery A, .	24.26	16.61	7.65
Average of Creamery B, .	23.45	16.13	7.30
Average of Station Dairy, .	26.56	19.22	7.34

Details of Farms contributing to Creamery A.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Number of Months since Last Calf. Less than 3 mos.	Number of Months since Last Calf. 3 mos. to 9 mos.	Number of Months since Last Calf. More than 9 mos.
1	4	–	17	–	4.25	–	5½	Three pure, one grade Jersey, .	Hay, corn fodder, pumpkins, .	None, . . .	– –	1	2	1
2	13	13	38	48	2.92	3.69	4	Pure and grade Jersey, . .	Rowen, hay, corn stalks, . .	4 qts. cob meal and rye,	Same, ...	–	6	5
3	7	5	28	20	4	4	4½	Jersey and native, . . .	Pasture (Nov.), rowen, stover, .	None, . . .	4 qts. meal and bran, . .	1	3	2
4	5	5	10	13	2	2.60	4	Grade Jersey, ...	Hay, corn fodder, . . .	4 qts. bran, . .	Same, ...	2	6	–
5	11	10	45	32	4.09	3.20	7	Pure and grade Jersey, Holstein, native, ...	Pasture (Nov.), hay, . . .	None, . . .	4 qts. bran, ...	–	5	–
6	2	6	10	21	5	3.50	7½	Grade Jersey, ...	Pasture (Nov.), soft corn, hay, .	None, . . .	4 qts. meal and bran, . .	4	2	–
7	5	6	13	29	2.60	4.83	6	Grade Durham, ...	Hay, corn fodder, . . .	Meal and bran, . .	8 qts. cob meal and bran, .	5	1	–
8	18	20	59	77	3.28	3.85	5	Grade Jersey, Holstein, Durham, Guernsey, . . .	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, with 1 qt. linseed, .	11	6	3
9	9	4	21	9	2.33	2.25	6½	Grade Jersey, Guernsey, native,	Rowen, corn stover, . . .	4 qts. cob meal and rye,	Same, ...	–	–	9
10	4	4	17	14	4.25	3.50	5	Grade Jersey, ...	Hay, sugar beets, . . .	4 qts. meal and bran,	Same, ...	1	3	–
11	9	12	31	55	3.33	4.51	7	Grade Jersey, Durham, native,	Pasture (Nov.), rowen, hay, .	2 qts. meal, . .	4 qts. bran, cotton seed, corn,	9	3	–
12	12	12	36	37	3	3.08	6½	Grade Durham, ...	Hay, corn fodder, . . .	4 qts. cob meal, .	5 qts. meal and bran, . .	1	6	5
13	15	17	48	52	3.20	3.06	6½	Grade Jersey, Holstein, native,	Hay, corn fodder, . . .	5 qts. meal, bran, rye,	Same, with broom seed, .	3	4	10

Details of Farms contributing to Creamery A—Continued.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
14	5	7	17	–	3.40	–	7	Grade Durham, ...	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, ...	2	5	–
15	24	24	86	82	3.58	3.41	$5\frac{1}{2}$	Grade Jersey, Holstein, native,	Rowen, corn fodder, . . .	2 qts. bran, 4 qts. cob meal, . . .	Same, ...	–	24	–
16	3	–	14	16	4.67	–	4	Grade Durham, Holstein, .	Pasture (Nov.), hay, . . .	3 qts. corn, rye, oats,	– –	2	1	–
17	6	6	25	23	4.17	3.83	8	Grade Jersey, Durham, Holstein, ...	Hay, corn fodder, . . .	5 qts. meal and bran,	Same, ...	–	3	3
18	10	10	47	19	4.70	1.90	8	Grade Durham, ...	Hay, corn fodder, . . .	None, . . .	None, ...	1	9	–
19	3	4	20	19	6.67	4.75	6	Grade Jersey and Ayrshire, .	Pasture (Nov.) hay, . . .	2 qts. meal and bran,	Same, ...	3	1	–
20	4	4	12	19	3	4.75	5	Grade Jersey, Holstein, native,	Pasture (Nov.), rowen, hay, .	None, . . .	6 qts. bran, ...	2	2	–
21	4	12	17	39	4.25	3.25	6	Grade Durham, Holstein, .	Rowen, hay, ...	2 qts. bran, . .	8 qts. meal and bran, . .	2	7	3
22	8	8	23	27	4.13	3.38	$4\frac{1}{2}$	Grade Durham, Holstein, .	Pasture, soft corn (Nov.), hay, .	None, . . .	4 qts. meal, ...	–	4	4
23	4	4	20	16	5	4	$5\frac{1}{2}$	Grade Jersey, native, Durham,	Pasture, soft corn (Nov.), hay, corn fodder, ...	None, . . .	6 qts. cob meal, . . .	1	2	1
24	9	9	30	31	3.34	3.44	$6\frac{1}{2}$	Native and grade Jersey, . .	Pumpkins (Nov.), hay, corn fodder, ...	4 qts. cob meal and bran, . . .	8 qts. cob meal and bran, .	–	5	4
25	3	6	18	34	6	5.67	5	Pure and grade Jersey, . .	Hay, corn fodder, . . .	7 qts. cob meal and bran, . . .	Same, ...	5	1	–

26	8	8	26	-	3.25	-	6½	Grade Jersey,	Pasture (Nov.), corn stover, hay,	None,	Bran,	-	-	-
27	2	3	5	10	2.50	3.33	4	Grade Jersey, Ayrshire,	Rowen, soft corn, corn stover,	None,	2 qts. meal and bran,	1	2	-
28	13	13	62	44	4.77	3.38	7½	Native, grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder, rowen,	None,	3 qts. meal and bran,	3	6	4
29	3	2	16	15	5.34	7.50	4	Grade Jersey,	Pumpkins (Nov.), hay, corn fodder,	None,	3 qts. meal and bran,	-	2	-
30	7	7	23	20	3.29	2.86	7	Pure Jersey,	Pasture (Nov.), hay, corn fodder,	None,	4 qts. cob meal and bran,	2	1	4
31	4	4	27	20	6.75	5	6	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	4 qts. corn, oats, bran,	Same,	4	-	-
32	4	4	11	-	2.75	-	8	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	-	-	-
33	3	3	8	-	2.67	-	8	Grade Durham, Holstein, Jersey,	Pasture (Nov.), hay,	None,	None,	-	-	-
34	3	3	18	13	6	4.33	6	Pure and grade Jersey,	Pasture (Nov.), hay, corn fodder,	None,	4 qts. meal and bran,	1	1	1
35	10	10	29	28	2.90	2.80	4	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	None,	None,	1	9	-
36	11	11	31	20	2.82	1.81	5½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	None,	4 qts. cob meal and rye,	6	5	-
37	7	7	38	46	5.43	6.57	6	Grade Durham, Holstein,	Hay, corn fodder,	4 qts. clear meal,	Same,	2	5	-
38	40	40	123	108	3.08	2.70	7½	Grade Durham, Holstein,	Hay, corn fodder,	4 qts. meal and bran,	Same,	1	35	4
39	4	4	13	14	3.25	3.50	6½	Grade Durham,	Hay, corn fodder,	4 qts. meal, oats and bran,	Same,	1	3	-
40	14	18	39	45	2.79	2.50	6½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	None,	4 qts. meal and bran,	3	18	-
41	7	11	35	33	5	3	7	Grade Durham,	Rowen, corn fodder,	None,	4 qts. cob meal and bran,	1	10	-
42	16	15	65	51	4.06	3.40	5	Grade Durham, Holstein,	Rowen, corn fodder,	2 qts. bran,	4 qts. meal, bran, rye,	6	9	-
43	4	4	20	17	5	4.25	7	Native,	Pasture (Nov.), rowen,	3 qts. bran,	Same,	-	-	-
44	12	12	30	34	2.50	2.83	8	Grade Durham,	Rowen, hay, pumpkins (Nov.), corn fodder,	2 qts. malt sprouts,	4 qts. bran,	10	2	-
45	3	6	16	40	5.34	6.67	5	Grade Jersey, native,	Sugar beets, hay, corn fodder,	6 qts. meal and bran,	Same,	3	1	2

Details of Farms contributing to Creamery A — Continued.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
46	4	4	15	–	3.75	–	4½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, rowen, .	4 qts. malt sprouts, .	Bran, ...	1	3	–
47	16	16	82	45*	5.13	2.81	6	Grade Jersey, native, . .	Hay, corn fodder, . . .	4 qts. clear meal, .	Same, ...	8	6	–
48	4	4	15	17	3.75	4.25	5	Grade Jersey, ...	Pasture (Nov.), hay, corn fodder,	None, . . .	Bran and meal, . . .	4	–	–
49	6	4	22	24	3.67	6	8	Pure Ayrshire, native, grade Holstein, ...	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same, ...	2	2	4
50	6	6	13	25	2.17	4.17	5	Grade Jersey, ...	Pasture (Nov.), rowen, corn stover, hay, ...	None, . . .	4 qts. meal and bran, . .	2	–	4
51	6	6	33	31	5.50	5.17	6	Grade Jersey, Durham, Ayrshire, Holstein, . . .	Hay, ...	3½ lbs. each, bran, meal and gluten, .	Same, ...	–	1	5
52	20	20	70	47	3.50	2.35	4½	Pure Jersey, Guernsey, Ayrshire, Holstein, . . .	Hay, ...	8 qts. bran, oats, cotton seed, . .	Same, ...	–	–	–
53	3	3	12	9	4	3	6	Grade Jersey, Holstein, . .	Pasture (Nov.), hay, corn stover,	None, . . .	None, ...	1	2	–
54	2	3	5	10	2.50	3.33	2	High-grade Jersey, Holstein, .	Pasture (Nov.), hay, squashes, .	None, . . .	6 qts. meal and middlings,	–	3	–
55	6	6	14	17	2.33	2.83	8	Grade Jersey, ...	Pasture (Nov.), hay, . . .	2 qts. meal, . .	Same, ...	1	4	1
56	13	15	22	43	1.69	2.87	6½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn stover,	None, . . .	4 qts. meal and bran, . .	6	8	1
57	5	9	21	38	4.20	4.22	4	High-grade Jersey, native, .	Pasture (Nov.), hay, . . .	2 qts. meal, oats, bran,	Same, ...	3	5	1
58	7	9	37	47	5.29	5.22	3½	Grade Jersey and Guernsey, .	Pasture (Nov.), hay, . . .	4 qts. provender, .	4 qts. bran, ...	9	–	–

59	8	6	26	21	3.25	3.50	4	Grade Jersey, Guernsey, Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	1	2
60	6	5	33	14	5.50	2.80	6½	Grade Jersey, Durham,	Pasture (Nov.), rowen, oats,	12 qts. meal and bran,	Same,	3	3	–
61	8	8	18	8	2.25	1	7	Grade Holstein, native,	Pasture (Nov.), hay, corn fodder,	None,	None,	–	8	–
62	5	5	24	22	4.80	4.40	7	Grade Jersey, Holstein,	Pasture (Nov.), hay, corn stover,	2 qts. bran,	4 qts. cob meal and bran,	5	–	–
63	6	6	31	27	5.17	4.50	5	Grade Jersey,	Pasture (Nov.), rowen, hay,	4 qts. bran,	Same,	–	6	–
64	11	11	30	28	2.73	2.55	5	Pure and grade Jersey, Holstein, Durham,	Hay, corn fodder,	4 qts. meal,	Same,	4	7	–
65	5	4	31	22	6.20	5.50	5	Grade Jersey,	Pasture (Nov.) hay,	2 qts. meal and bran,	Same,	4	–	–
66	5	5	25	17	5	3.40	5	Pure and grade Jersey, Holstein,	Pasture (Nov.), hay,	2 qts. meal,	Same,	1	4	–
67	6	6	22	23	3.67	3.83	7½	Grade Jersey, Holstein, native,	Pasture (Nov.), hay, corn fodder,	1 qt. meal, 3 qts. bran,	1½ qts. meal, 4 qts. bran,	–	6	–
68	7	7	30	–	4.29	–	5	Grade Holstein and Durham,	Pasture (Nov.), rowen, corn stover,	4 qts. meal and bran,	Same,	3	2	2
69	7	7	45	34	6.43	4.86	4½	Grade Jersey and Durham,	Pasture (Nov.), hay,	4 qts. meal and bran,	Same,	2	5	–
70	4	4	9	6	2.25	1.50	6	Grade Jersey,	Pasture (Nov.), hay,	None,	None,	–	4	–
71	10	10	38	43	3.80	4.30	6	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	3 qts. meal and bran,	8 qts. meal and bran,	5	5	–
72	13	13	44	44	3.38	3.38	5½	Grade Jersey, native,	Hay, corn stover,	5 qts. cob meal and shorts,	Same,	3	2	6
73	5	5	13	23	2.60	4.60	6	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. meal and bran,	Same,	4	1	–
74	3	3	3	7	1	2.33	2½	Grade Jersey, Durham, Devon,	Pasture (Nov.), hay, corn fodder,	None,	Bran,	3	–	–
75	14	–	53	48	3.79	–	5	Grade Jersey,	Hay,	8 qts. meal and bran,	Same,	–	–	–
76	4	4	12	12	3	3	2	High-grade Jersey, grade Durham,	Hay,	6 qts. bran, bakery waste,	Same,	–	–	–
77	6	6	26	24	4.33	4	6	Grade Jersey, native,	Hay, rowen, corn fodder,	4 qts. bran, 2 qts. meal,	Same,	–	–	–

* Sells milk.

Details of Farms contributing to Creamery A — Continued.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
78	12	12	28	27	2.33	2.25	4	Pure and grade Jersey,	Pasture (Nov.), hay, corn stover,	None,	None,	–	–	–
79	12	12	4*	–*	.33	–	4	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. bran and meal,	Same,	–	–	–
80	7	6	14	17	2	2.83	8	Grade Jersey,	Hay,	2 qts. bran,	Same,	–	–	7
81	6	6	11	13	1.83	2.17	5	Grade Jersey and Durham,	Hay, corn stover,	None,	2 qts. fine feed,	1	4	1
82	4	4	31	26	7.75	6.50	6	Pure Jersey,	Hay,	6 qts. meal and bran,	Same,	4	–	–
83	6	6	26	24	4.33	4	7	Grade Jersey, native,	Hay, corn fodder,	5 qts. bran, 2 qts. meal,	Same,	2	4	–
84	7	7	20	16	2.86	2.29	6	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	2 qts. meal,	Same,	–	–	–
85	8	8	24	25	3	3.13	5	Grade Jersey, Durham,	Hay, corn fodder,	1 qt. meal and bran,	Same,	1	4	3
86	5	5	20	20	5	5	6½	Pure and grade Jersey, grade Guernsey,	Hay, corn stover,	6 qts. meal and bran,	Same,	–	5	–
87	7	7	13	–	1.86	–	5	Grade Jersey,	Hay, corn fodder,	3 qts. meal and bran,	Same,	2	4	–
88	8	8	21	13	2.63	1.63	5	Native,	Hay, corn fodder,	4 qts. bran, 2 qts. meal,	Same,	3	5	–
89	6	6	19	16	3.17	2.67	6	Native,	Pasture (Nov.), hay, corn fodder,	4 qts. bran,	4 qts. bran, 2 qts. meal,	1	4	1
90	7	3	7	13	2.43	4.33	4½	Grade Jersey,	Hay, rowen, corn fodder,	4 qts. bran, rye, corn,	Same,	2	1	–
91	8	8	27	16	3.38	2	7	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	–	4	4

92	12	12	41	31	3.42	2.58	6	Grade Jersey, Durham, Holstein, native,	Pasture (Nov.), rowen, corn stover,	2 qts. meal and bran,	Same,	2	5	5
93	5	5	13	13	2.60	2.60	6	Native,	Pasture (Nov.), rowen, corn stover,	None,	None,	–	4	1
94	18	18	80	71	4.44	3.94	6	Grade Jersey, native,	Hay, corn fodder,	Meal and bran,	Same,	–	–	–
95	7	7	26	20	3.71	2.86	6	Grade Jersey,	Pasture (Nov.), oats, hay, corn fodder,	None,	3 qts. cob meal and oats,	1	3	3
96	5	5	23	18	4.60	3.60	5	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	2 qts. bran,	4 qts. meal and bran,	–	5	–
97	2	–	6	–*	3	–	4½	High-grade Jersey,	Pasture (Nov.), hay,	5 qts., ⅓ rye, ⅔ corn,	4 qts. corn and rye,	10	2	–
98	12	12	55	50	4.58	4.17	6	Grade Jersey and Durham,	Pasture (Nov.), hay,	2 qts. meal, 4 qts. bran,	Same,	–	12	–
99	11	11	54	46	4.91	4.18	6	Grade Jersey, Durham,	Soft corn (Nov.), corn fodder, rowen, hay,	None,	4 qts. corn and oats,	3	1	7
100	12	12	45	49	3.75	4.08	4	Grade Durham, Holstein, Hereford, Devon,	Pasture (Nov.), hay, corn fodder,	3 qts. bran,	Same,	2	10	–
101	13	14	77	70	5.92	5	7	Grade Jersey,	Rowen, hay, corn fodder,	4 qts. meal and bran,	3 qts. meal, 2 qts. shorts,	7	6	1
102	7	9	31	35	4.43	3.89	7	Grade Jersey, Guernsey, Holstein, native,	Hay, corn fodder,	8 qts. meal, bran, middlings,	4 qts. meal and middlings,	5	4	–
103	5	5	25	23	5	4.60	4½	Grade Jersey, native,	Hay, corn fodder,	None,	1 qt. meal,	2	3	–
104	10	10	42	56	4.20	5.60	3½	Grade and pure Guernsey,	Hay,	4 qts. meal and middlings,	Same,	1	6	3
105	8	8	36	31	4.50	3.88	6½	Pure and grade Jersey,	Hay, corn stover,	3 qts. meal,	Same,	–	–	8
106	2	6	9	19	4.50	3.17	7½	Pure Jersey and Hereford,	Hay, corn fodder,	8 qts. meal and bran,	Same,	–	6	–
107	7	–	26	36	3.71	–	5	Grade Jersey, Durham,	Hay, corn fodder,	2 qts. meal and bran,	Same,	–	–	–
108	5	5	19	20	3.80	4	5	Grade Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	2	–
109	4	4	16	15	4	3.75	5	Pure and grade Jersey,	Hay, corn fodder,	Meal,	Same,	2	2	–

* Sells milk.

Details of Farms contributing to Creamery A — Concluded.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
110	9	9	21	31	2.33	3.44	5½	Grade Jersey, Holstein, native,	Hay, corn stover,	4 qts. meal and bran,	Same,	1	8	–
111	6	12	17	30	2.83	2.50	6	Grade Durham,	Hay, corn stover,	Meal and bran,	Same,	–	11	1
112	11	11	26	31	2.36	2.82	6	Grade Jersey, native,	Hay, corn stover,	6 qts. meal, bran, oats,	Same,	–	11	–
113	10	10	27	55	2.70	5.50	3½	Grade Jersey, Ayrshire,	Pasture (Nov.), hay,	None,	None,	1	9	–
114	4	4	13	10	3.25	2.50	5	Grade Jersey, native,	Hay,	4 qts. meal,	Same,	–	4	–
115	5	6	24	32	4.80	5.33	5½	Grade Jersey, Durham,	Rowen, corn stover,	4 qts. meal and bran,	Same,	2	4	–
116	2	2	10	14	5	7	5	Grade Jersey, Ayrshire, native,	Rowen, hay, corn stover,	4 qts. cob meal,	Same,	1	1	–
117	4	4	18	20	4.50	5	5	Grade Jersey, Durham,	Hay, corn stover,	5½ qts. meal and bran,	7 qts. meal and bran,	1	3	–
118	6	6	24	20	4	3.33	4½	Grade Jersey, Holstein, native,	Hay,	3 qts. corn and rye,	Same,	2	4	–
119	13	13	48	40	3.69	3.08	5½	Grade Jersey, Ayrshire,	Hay, corn fodder,	8 qts. meal and middlings,	Same,	2	11	–
120	10	–	51	57	5.10	–	4	Grade Jersey,	Hay, corn fodder,	6 qts. meal and bran,	Same,	4	6	–
121	13	13	23	29	1.77	2.23	5	Grade Durham, Guernsey, pure Holstein,	Pasture (Nov.), hay, corn fodder,	4½ qts. meal and bran,	Same,	3	6	4
122	7	10	31	48	4.43	4.80	6	Grade Jersey, Ayrshire,	Pasture (Nov.), hay, corn stover,	3 qts. meal and bran,	4½ qts. cob meal, bran, rye,	4	2	4
123	8	8	19	10	2.38	1.25	7	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	4 qts. meal,	Same,	–	8	–

124	6	6	14	23	2.33	3.83	5	Pure and grade Jersey, grade Durham, Ayrshire, . .	Rowen, corn fodder, . . .	None, . . .	4 qts. cob meal, . . .	2	4	–
125	13	20	52	48	4	2.40	5½	Grade Holstein, native, . .	Hay, corn stover, . . .	6 qts. meal and bran,	3 qts. cob meal, . . .	–	20	–
126	4	4	13	14	3.25	3.50	4½	Native, ...	Hay, corn stover, . . .	1 qt. meal, . .	Same, ...	1	2	1
127	5	5	22	18	4.40	3.60	5	Grade Jersey, ...	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, ...	1	3	1
128	19	19	63	58	3.33	3.06	6	Grade Jersey, Durham, . .	Pasture (Nov.), hay, corn fodder,	4 qts. bran, . .	Same, ...	3	10	5
129	7	7	27	23	3.85	3.29	6	Grade Jersey, Durham, . .	Rowen, corn fodder, . . .	4 qts. meal, . .	Same, ...	3	2	2
130	–	6	–	43	–	7.17	5	Grade Jersey, Holstein, . .	Hay, corn fodder, . . .	– –	4 qts. cob meal, 6 qts. bran,	5	1	–
131	–	4	–	11	–	2.75	6	Grade Jersey, ...	Hay, ...	– –	2 qts. cob meal and bran, .	3	1	–

Details of Farms contributing to Creamery B.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Number of Months since Last Calf. Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
1	3	3	13	12	3.33	4	5	Grade Jersey,	Rowen, oat straw,	6 qts. meal and bran,	Same,	1	2	–
2	4	4	9	10	2.25	2.50	4	Grade Jersey, Durham, native,	Rowen, hay,	None,	None,	–	–	4
3	6	6	17	14	2.83	2.33	$8\frac{1}{2}$	Grade Holstein, native,	Pasture (Nov.), rowen,	None,	None,	–	3	3
4	14	6	32	22	2.29	3.67	6	Grade Jersey, Durham, Holstein,	Hay, corn fodder,	2 qts. meal, 4 qts. bran,	Same,	2	6	6
5	8	7	20	21	2.50	3	$5\frac{1}{2}$	Grade Jersey,	Pasture (Nov.), rowen, corn stover,	None,	None,	–	6	2
6	11	12	58	47	5.27	3.91	$6\frac{1}{2}$	Grade Jersey,	Pasture (Nov.) hay,	4 qts. bran,	4 qts. meal and bran,	2	3	3
7	9	9	40	43	4.44	4.77	8	Grade Jersey, Durham, Hereford,	Pasture (Nov.), hay, oats, corn stover,	Meal and bran,	2 qts. meal and bran,	–	5	4
8	11	11	34	32	3.09	2.90	7	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	None,	6 qts. meal and bran,	–	4	7
9	5	8	7	22	1.40	2.75	$5\frac{1}{2}$	Pure and grade Jersey, grade Durham,	Pasture (Nov.), hay, potatoes (Nov.),	4 qts. bran,	4 qts. meal and bran,	1	5	2
10	6	6	32	24	5.16	4	4	Grade Jersey, Durham,	Pasture (Nov.), hay, rowen,	None,	2 qts. meal and bran,	1	3	2
11	4	4	13	9	3.25	2.25	5	Grade Jersey, Ayrshire,	Pasture (Nov.), hay,	None,	2 qts. meal,	1	2	1

12	5	4	8	7	1.60	1.75	5	Natives,	Hay, corn fodder,	None,	None,	1	2	1
13	13	12	37	43	2.85	3.58	6	Grade Jersey, native,	Hay, corn fodder,	2 qts. cob meal,	4 qts. cob meal,	2	5	5
14	8	9	41	40	5.12	4.44	6½	Pure and grade Jersey, pure Durham, natives,	Rowen, hay, soft corn,	8 qts. meal and bran,	Same,	3	4	2
15	6	6	20	23	3.33	3.83	6	Grade Jersey,	Hay,	3 qts. meal and bran,	Same,	2	3	1
16	4	4	22	21	5.50	5.25	6	Pure and grade Jersey,	Oats and straw, hay,	Meal and bran,	Same,	3	1	–
17	3	3	19	17	6.33	5.67	4	Pure Jersey and grades,	Rowen,	6 qts. meal and bran,	Same,	–	3	–
18	11	11	39	34	3.54	3.09	6½	Grade Jersey, native,	Pasture (Nov.), hay,	None,	4 qts. meal and bran,	2	8	1
19	14	15	67	65	4.79	4.33	6	Grade Jersey, Durham, native,	Pasture (Nov.), hay, rowen, corn stover,	4 qts. ⅔ meal, ⅓ bran,	6 qts. ⅔ meal ⅓ bran,	13	1	–
20	4	6	18	18	4.50	3	6	Grade Jersey, native,	Pasture (Nov.), hay, corn stover, rowen,	None,	1½ qts. meal and rye,	2	2	–
21	22	16	61	33*	2.69	2.06	5	Grade Jersey,	Hay, corn fodder (Dec.),	4 qts. meal and bran,	Same,	5	9	2
22	6	7	19	26	3.16	3.71	6	Pure and grade Jersey,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	4	–
23	5	4	18	14	3.60	3.50	3	Grade Jersey, Holstein, native,	Hay, rowen, corn fodder,	1 qt. meal, 2 qts. bran,	Same,	1	3	–
24	6	3	10	12	1.66	4	5	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. meal and bran,	Same,	–	2	1
25	17	16	72	74*	4.18	4.62	6	Grade Jersey, Devon,	Rowen, hay, barley, corn stover,	3 qts. meal, 2 qts. bran,	Same,	6	8	2
26	4	5	19	22	4.75	4.40	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn stover,	None,	4 qts. cob meal and bran,	4	–	–
27	8	6	21	24	2.62	4	5	Grade Jersey,	Pasture (Nov.), rowen, corn stover,	None,	2 qts. corn and rye,	5	1	–
28	10	8	35	31	3.50	3.87	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	3 qts. bran,	3 qts. meal and bran,	–	4	6
29	12	12	26	43	2.17	3.58	4	Grade Jersey, Holstein, Durham,	Pasture (Nov.), hay, corn fodder,	None,	3 qts. meal and bran,	–	5	7
30	13	10	42	31	3.23	3.10	5½	Grade Holstein,	Hay, corn fodder,	2 qts. cob meal,	4 qts. meal and bran,	–	5	5
31	4	4	11	21	2.75	5.25	4	Grade Jersey,	Hay, corn fodder,	2 qts. meal and bran,	Same,	2	2	–

* Sells milk.

Details of Farms contributing to Creamery B — Concluded.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Number of Months since Last Calf. Less than 3 mos.	Number of Months since Last Calf. 3 mos. to 9 mos.	Number of Months since Last Calf. More than 9 mos.
32	7	7	31	22	4.43	3.14	6	Grade Jersey, Ayrshire,	Hay,	1½ qts. meal,	Same,	–	–	–
33	4	3	14	14	3.50	4.66	5½	Pure and grade Jersey,	Pasture (Nov.), hay,	1 qt. meal,	3 qts. meal,	3	1	–
34	2	4	15	26	7.50	6.50	6	Grade Durham,	Hay, corn stover,	None,	Corn,	3	1	–
35	2	2	9	7	4.50	3.50	5	Grade Jersey,	Hay,	Bran,	2 qts. meal, 1 qt. bran,	–	2	–
36	20	–	98	42	4.90	–	8	Grade and pure Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	–	–	–
37	13	20	72	82	4	4.10	6	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	15	3	2
38	7	8	24	34	3.43	4.25	6	Grade Holstein, Durham, native,	Pasture (Nov.), rowen, corn fodder,	8 qts. cob meal and bran,	Same,	2	6	–
39	14	14	42	45	3.00	3.21	5	Native,	Hay, corn fodder,	6 qts. meal and bran,	Same,	–	8	6
40	7	8	23	23	3.28	2.87	7	Grade Holstein, Jersey, Durham,	Pasture (Nov.), rowen,	None,	5 qts. cob meal and bran,	2	6	–
41	13	13	46	52	3.53	4	7	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	6 qts. meal and bran,	Same,	1	12	–
42	9	9	21	32	2.33	3.44	6	Pure and grade Jersey,	Pasture (Nov.), rowen, corn fodder,	4 qts. bran,	Same,	3	5	1
43	7	7	18	18	2.57	2.57	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn stover,	None,	8 qts. meal and bran,	–	7	–
44	8	9	11	26	1.37	2.88	7	Grade Jersey, Holstein,	Hay,	Bran,	6 lbs. meal and bran,	5	2	2

45	7	7	16	20	2.28	2.85	6½	Grade Jersey, native, . .	Hay, corn stover, . . .	None, . . .	2 qts. meal, . . .	1	3	3
46	6	6	18	14	3	2.33	6	Grade Jersey, ...	Hay, corn fodder, . . .	7 qts. meal and bran,	Same, ...	2	1	3
47	7	7	14	24	2	3.42	6	Grade Durham, native, . .	Pasture (Nov.), hay, corn stover,	4 qts. bran, . .	4 qts. cob meal, . . .	3	3	1
48	7	7	28	25	4	3.57	4½	Grade Jersey, Holstein, . .	Hay, corn fodder, . . .	Meal and bran, . .	4 qts. meal and bran, . .	3	4	–
49	5	5	28	24	5.60	4.80	6½	Pure Jersey, grade Durham, Devon, Ayrshire, . . .	Pasture (Nov.), hay, corn fodder,	1 qt. meal, 2 qts. bran,	Same, ...	2	–	3
50	9	9	29	35	3.22	3.88	7	Grade Jersey, Holstein, Durham,	Hay, ...	6 qts. bran, . .	Same, ...	2	3	4
51	8	8	26	–	3.25	–	6	Grade Jersey, Durham, Guernsey, Devon, Ayrshire, . .	Grass (Nov.), hay, . . .	3 qts. meal, . .	Same, ...	–	–	–
52	7	7	21	15	3	2.14	6	Grade Jersey, Ayrshire, . .	Hay, corn fodder, . . .	Corn, oats, bran, .	Same, ...	–	–	–
53	5	6	20	19	4	3.16	4½	Grade Jersey, Guernsey, native,	Hay, corn stover, . . .	6 qts. meal and bran,	Same, ...	3	3	–
54	4	4	13	8	3.25	2	5½	Grade Jersey, Guernsey, Durham, Ayrshire, . . .	Hay, ...	None, . . .	None, ...	–	2	2
55	2	3	10	7	5	2.33	4½	Grade Jersey, native, . .	Hay, corn fodder, pumpkins (Nov.), ...	None, . . .	Cob meal, ...	–	2	1
56	3	2	11	4	3.67	2	4½	Grade Jersey, Durham, . .	Pasture (Nov.), hay, corn fodder,	None, . . .	3 qts. meal, ...	–	3	–
57	11	11	35	24	3.18	2.18	6½	Grade Jersey, Ayrshire, . .	Hay, oats, corn fodder, . .	4 qts. meal and bran,	Same, ...	–	11	–
58	6	6	10	–	1.67	–	4	Grade Jersey, ...	Pasture (Nov.), hay, corn fodder,	None, . . .	– –	–	–	–
59	14	14	37	22	2.64	1.57	6½	Grade Jersey, Holstein, . .	Hay, oats, corn fodder, . .	None, . . .	2 qts. meal, ...	2	6	3
60	3	3	12	20	4	6.67	6	Grade Durham, ...	Pasture (Nov.), hay, . . .	8 qts. meal and bran,	Same, ...	2	1	–
61	5	4	16	13	3.20	3.25	4½	Grade Jersey, ...	Pasture (Nov.), hay, corn fodder, pumpkins (Nov.), . .	Meal and bran, . .	4 qts. meal and middlings,	–	4	–
62	–	6	–	41	–	6.83	5	Grade Jersey, ...	Hay, ...	– –	3 qts. meal, ...	4	1	1

Summary.

	Creamery A.	Creamery B.
Number of farms contributing,	131,	62
Total spaces of cream Nov. (1 day),	3,671,	1,668
Total spaces of cream Dec. (1 day),	3,470,	1,593
Total number of cows Nov. (1 day),	1,013,	483
Total number of cows Dec. (1 day),	1,033,	456
Lowest space per cow,*	1 (Farm Nos. 61 and 74),	1.40 (Farm No. 9).
Highest space per cow,	7.75 (Farm No. 82),	7.50 (Farm No. 34).
Average spaces per cow,	3.49,	3.42
Average age of cows,	5¾ years,	5½ years.
Average space per cow in station dairy, 5.25.		

* Excluding cases where milk is sold.

V. Feeding Experiments with Pigs.

The preceding annual report contains a summary of a series of feeding experiments with pigs, carried on at this station since 1884, for the purpose of ascertaining the cost of the feed required to produce a given quantity of dressed pork. Our first attention in this connection was directed towards a profitable disposition of two by-products of the dairy industry, — skim-milk and buttermilk from creameries. As the daily supply of these materials varies, for obvious reasons, widely on farms, it seemed advisable to devise economical fodder rations adapted to different conditions in that direction.

The daily diet in our earlier experiments contained a more liberal amount of milk than in our later ones. For several years past we have raised, the whole year around, for every cow on our farm, a pig for the meat market, to dispose of our skim-milk. This course necessitated, at times, additional resources of supply of nutritious food. To meet this requirement in an economical and profitable way, and by means which are in the reach of every farmer, has been our aim. How we have thus far succeeded in our endeavor, may be ascertained from a subsequent short review of our previous course of observation. A correct interpretation of our latest feeding experiment (X.), which forms the principal part of the subsequent communication, renders a brief restatement of the results of our earlier experiments advisable.

During our first and second experiments (1884), skim-milk or buttermilk or both and corn meal furnished the daily feed. In the first experiment, the relative proportions of skim-milk or of buttermilk and of corn meal remained the same from the beginning to the end of the trial; namely, three ounces of corn meal for every quart of skim-milk required to meet the increasing wants of the animals. The daily average consumption per head amounted at the close of the experiment to fourteen quarts of skim-milk and forty-two ounces of corn meal. The nutritive character of the daily diet remained practically the same during most of the time of observation. It was, in the case of the buttermilk diet, one part of digestible nitrogenous food constituents to

from 2.84 to 3.38 parts of non-nitrogenous food constituents; and in case of that of the skim-milk, one of the former to from 2.50 to 2.90 of the latter; the variations being mainly due to the difference in the amount of solid matter in the two kinds of milk.

In the second feeding experiment (1885), the relative proportion between skim-milk or buttermilk and corn meal was different from that in the first one. During the first period of the second experiment, only two ounces of corn meal were added to each quart of milk required to satisfy the animal. As soon, however, as from six to seven quarts per head were consumed daily, four ounces of corn meal were fed for every quart of milk. Another increase in corn meal was made when ten quarts of milk were called for: and again, when twelve quarts were consumed per head. The experiment closed with a daily average ration per head of from ten to twelve quarts of milk, and from eighty to ninety-six ounces of corn meal. In consequence of this course of feeding, the nutritive character of the daily diet was changed from time to time. The periodical increase of corn meal in the daily fodder rations caused the introduction of a larger proportion of non-nitrogenous food constituents, as starch, sugar, fat, etc., in the diet, than of nitrogenous constituents. The experiment began with a diet which contained one part of digestible nitrogenous constituents to 2.7 of non-nitrogenous food constituents, and closed with 1 : 5 in case of skim-milk and 1 : 4.5 in case of buttermilk.

The expiration of a contract with a creamery in our vicinity deprived us, at that stage of our investigation, of a liberal supply of buttermilk. A limited supply of home-made skim-milk necessitated a modification of our feeding system, in case that at least six pigs should be engaged in the experiments at one time. It was therefore decided to feed the skim-milk from our herd of six cows, in equal quantities, to six growing pigs, and to supply the additional feed from other suitable sources, including corn meal in part. It seemed also of interest to learn whether the particular course pursued in the previously described experiments of feeding skim-milk from the home dairy with corn meal alone could be improved on; and, if so, in what direction. Gluten

meal and wheat bran were chosen, for various reasons, to serve in connection with corn meal to furnish the additional ingredients of the diet, as soon as our milk supply became exhausted. This course promised to serve two distinct purposes: —

1. The rich nitrogenous character of gluten meal and of wheat bran offered a chance to secure any desired change in the nutritive character of the feed, as far as the relative proportion of the digestible nitrogenous and non-nitrogenous food constituents are concerned; and

2. To reduce the net cost of the feed, in case they proved to be an efficient substitute for larger quantities of corn meal, on account of the larger quantities of certain essential fertilizing constituents they contain.

The statement that an addition of gluten meal or of wheat bran or both, to a diet which previously consisted only of skim-milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

1. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

2. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potassium oxide, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that particular diet as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable

fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources of skim-milk.

The daily supply of skim-milk has not exceeded, at any period, eight quarts of milk during our later experiments, from the third to the ninth inclusive; most of the time it has been from four to five quarts per head. The relative proportion of corn meal, wheat bran and gluten meal has been frequently altered in case of different experiments, as well as at different stages of the same experiment, with varying results. The ninth experiment, which has been described in detail in our sixth annual report, has been, from an economical stand-point, thus far the most successful one. A brief abstract of that experiment may here suffice to show our late mode of compounding fodder rations for pigs at different stages of growth, in connection with the financial results we secured.

The summary includes our entire series of pig feeding described in previous reports, and also the last one, the tenth, which is for the first time published in detail in some succeeding pages.

Average of Daily Rations (Experiment IX.).

	Corn Meal (Ounces).	Skim-milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Corn and Cob Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, .	–	3	–	–	6.	I.	1 : 2.80
April 24 to May 1, .	–	6	–	–	12.		
May 2 to May 14, .	–	6	3.47	6.94	12.	II.	1 : 2.53
May 15 to May 28, .	–	6	9.89	19.78	12.		
May 29 to June 4, .	–	6	10.67	21.34	12.		
June 5 to June 22, .	–	6	8.65	8.65	34.60	III.	1 : 3.63
June 23 to July 3, .	–	6	9.86	9.86	39.44		
July 4 to July 9, .	–	6	7.70	7.70	46.20	IV.	1 : 4 35
July 10 to July 25, .	56.10	6	9.35	9.35	–		
July 26 to Aug. 8, .	63.00	6	10.50	10.50	–		

EXPERIMENT IX.	Live Weight of Animal.	Nutritive Ratio.
Period I., .	20 to 90 pounds, .	One digestible nitrogenous, 2.66 digestible non-nitrogenous, constituents
Period II., .	90 to 130 pounds, .	One digestible nitrogenous, 3.62 digestible non-nitrogenous, constituents.
Period III., .	130 to 200 pounds, .	One digestible nitrogenous, 4.35 digestible non-nitrogenous, constituents.

The calculations included in the following summary were based upon the following valuations per ton: —

	Cost.	Manurial Value.
Corn meal, ...	$24 00	$7 97
Barley meal, ...	30 00	6 21
Skim-milk (10 per cent. solids), . .	1.8 cts. gal.	2 25
Buttermilk (7 to 8 per cent. solids), . .	1.37 " "	1 74
Corn and cob meal, ...	$20 70	6 06
Wheat bran, ...	22 50	13 51
Gluten meal, ...	22 50	17 49

Summary of Experiments I. to X.

[Based on the same cost of feed and value of manurial refuse.]

EXPERIMENT.	Number of Pigs.	Average Weight of Pigs at Beginning of Experiment (Pounds).	Average Weight of Pigs at Close of Experiment (Pounds).	Articles of Fodder used.	Nutritive Ratio of Feed.	Pounds of Dry Matter consumed for the Production of One Pound of Dressed Pork.	Total Cost of Feed per Pound of Dressed Pork (Cents).	Manurial Value of Feed per Pound of Dressed Pork, after deducting Thirty Per Cent. taken by Pig (Cents).	Net Cost of Feed per Pound of Dressed Pork (Cents).
I. May 21 to Sept. 22, 1884, a,	3	48.8	239.0	Skim-milk, corn meal, .	1 : 2.50 to 1 : 2.97	2.50 to 3.11; average 2.90	5.15	1.70	3.45
b,	3	47.6	253.9	Buttermilk, corn meal, .	1 : 2.84 to 1 : 3.38	2.23 to 2.57; " 2.40	4.30	1.38	2.92
II. Nov. 5, 1884, to Mar. 21, 1885, a,	6	30.1	209.7	Buttermilk, corn meal, .	1 : 3.5 to 1 : 4.8	3.34 to 4.17; " 3.67	5.91	1.80	4.11
b,	6	28.7	227.0	Skim milk, corn meal, .	1 : 2.7 to 1 : 5.00	2.97 to 3.48; " 3.31	5.51	1.69	3.82
III. April 1 to Sept. 16, 1885, . .	2	49.8	276.3	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 3.04 to 1 : 3.76	4.01 to 4.18; " 4.10	6.41	2.01	4.40
IV. Dec. 8, 1885, to May 31, 1886, .	2	32.9	152.4	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 2.64 to 1 : 4.48	3.77 to 4.08; " 3.93	6.33	2.13	4.20
V. Sept. 15, 1886, to Jan. 19, 1887, .	4	32.6	175.0	Skim milk, corn meal, . Wheat bran, gluten meal,	1 : 2.75 to 1 : 3.57	3.56 to 4.31; " 3.92	5.40	2.02	3.38
VI. Feb. 17 to May 2, 1887, . . .	5	54.4	152.8	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 2.99 to 1 : 3.23	2.70 to 4.20; " 3.68	5.69	1.95	3.74
VII. June 28 to Oct. 26, 1887, . .	7	21.5	193.3	Skim milk, corn meal, . Wheat bran, gluten meal,	1 : 2.85 to 1 : 4.30	2.83 to 3.24; " 3.07	5.15	1.76	3.39
VIII. Nov. 8, 1887, to March 12, 1888, .	6	25.2	186.4	Skim-milk, corn meal, . Wheat bran, gluten meal, Corn and cob meal, . .	1 : 2.30 to 1 : 4.17	3.02 to 3.46; " 3.27	5.32	1.74	3.58
IX. April 12 to Aug. 8, 1888, . .	6	19.6	194.7	Skim milk, corn meal, . Wheat bran, gluten meal, Corn and cob meal, . .	1 : 2.53 to 1 : 4.35	2.81 to 3.17; " 3.00	4.89	1.62	3.27
X. April 26 to Aug. 28, 1889, . .	7	20.3	189.9	Skim-milk, barley meal, . Wheat bran, gluten meal,	1 : 2.90 to 1 : 4.65	3.40 to 3.81; " 3.60	6.07	1.75	4.32

Our observations in this connection with the management of the above summarized ten feeding experiments, lead to the following suggestions regarding a proper course of raising pigs for the meat market: —

1. Begin as early as practicable, with a well-regulated system of feeding. During the moderate season, begin when the animals have reached from eighteen to twenty pounds in live weight; in the colder seasons, when they weigh from twenty-five to thirty pounds.

2. The feed for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs, and to make them thereafter good eaters. A liberal supply of skim-milk or buttermilk, with a periodical increase of corn meal, beginning with two ounces of corn meal per quart of milk, has given us highly satisfactory results.

3. Change the character of the diet, at certain stages of growth, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed. Begin, for instance, with two ounces of corn meal to one quart of skim-milk; when the animal has reached from sixty to seventy pounds, use four ounces per quart; and feed six ounces of meal per quart after its live weight amounts to from one hundred and twenty to one hundred and thirty pounds. The superior feeding effect noticed in case of one and the same diet during the earlier stages of growth, will not infrequently be found to decrease seriously during later stages.

4. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from one hundred and seventy-five to one hundred and eighty pounds is only advisable when exceptionally high market prices for dressed pork can be secured. The quality of the meat is also apt to be impaired by an increased deposition of fat. The power of assimilating food and of converting it in an economical way into an increase of live weight, decreases with the progress of age.

5. It pays well, as far as the cost of feed is concerned, to protect the animals against the extremes of the season. Feeding experiments carried on during moderate seasons are more profitable than those carried on, under otherwise corresponding circumstances, during the winter season.

Weights taken at Time of killing of Pigs fattened at the Experiment Station (in Pounds).

[Age of pigs when killed, five to eight months.]

NUMBER AND BREED OF PIG.	Live Weight.	Dressed Weight.	Per Cent. of Live Weight lost by Dressing.	Heart.	Lungs.	Liver.	Heart, Lungs and Liver.	Stomach (empty).	Intestinal Fat.
1. Yorkshire — Berkshire,	231.25	194.50	15.89	–	–	–	4.25	1.25	4.50
2. " "	247.00	203.75	17.50	–	–	–	6.00	1.50	5.00
3. " "	218.50	183.25	16.13	–	–	–	4.50	1.25	5.00
4. Yorkshire — White Chester,	165.00	132.75	19.50	–	–	–	4.25	1.25	3.75
5. " " "	197.75	161.50	18.35	–	–	–	5.00	1.50	4.00
6. " " "	198.50	159.50	19.64	–	–	–	5.25	1.25	5.00
7. Yorkshire — Berkshire,	253.25	208.50	17.67	–	–	–	5.75	1.25	6.00
8. " "	243.25	205.25	15.60	–	–	–	5.25	1.50	4.00
9. " "	249.25	209.25	16 00	–	–	–	6.00	1.75	6.00
10. Yorkshire — White Chester,	209.00	168.50	19.10	–	–	–	6.00	1.50	4.50
11. " " "	191.00	158.50	17.02	–	–	–	5.50	1 25	5.25
12. " " "	216.25	173.50	19.77	–	–	–	5.50	1.25	6.00
13. Mixed,	196.00	167.50	14.54	–	–	–	4.25	1 25	1.75
14. "	306.00	258.00	15.69	–	–	–	6.50	1.50	5.50
15. "	178.50	150.50	15.69	–	–	–	3.75	1.00	2.50
16. "	246.50	210.00	14.81	–	–	–	5.00	1.25	4 75
17. "	164.00	137.00	16.46	.50	.75	2.25	3.50	–	2 50
18. "	193.25	163.00	15.65	.50	.75	2.75	4.00	–	2 25
19. "	178.25	153.00	14.16	.33	1.25	2.00	3.58	–	1.75
20. Berkshire — White Chester,	204.00	162.00	20.59	.63	1.25	3.75	5.63	–	2.38
21. " " "	184.00	145.00	21.20	.50	1.06	3.25	4.81	–	2.19
22. " " "	201.00	156.00	22.39	.50	1 21	3.75	5.46	–	3 38

23. Berkshire — White Chester,	193.00	158.00	18.15	.56	1.44	3.00	5.06	–	2.63
24. " " "	197.00	156.00	20.81	.53	1.13	3.75	5.41	–	2.88
25. " " "	184.50	144.00	21.95	.44	0.81	3.75	5.00	–	3.25
26. " " "	189.50	148.00	21.90	.50	1.00	3.75	5.25	–	3.13
27. Mixed,	189.00	154.00	18.52	.56	1.32	3.32	5.20	–	2.50
28. "	198.00	160.00	19.19	.50	1.50	3.00	5.00	–	3.81
29. "	187.00	151.00	19.25	.50	1.50	3.06	5.06	–	2.44
30. "	181.50	150.00	17.31	.44	1.19	3.44	5.07	–	2.50
31. "	184.50	150.00	18.70	.44	1.38	3.32	5.14	–	3.00
32. "	200.75	162.00	19.30	.69	1.56	3.63	5.88	–	3.38
33. "	185.75	152.00	18.17	.56	1.56	2.63	4.75	–	1.88
34. "	190.25	158.00	16.93	.50	1.13	3.00	4.63	–	2.69
35. "	188.75	154.00	18.15	.75	1.19	2.38	4.32	–	2.38
36. "	193.75	158.00	18.45	.75	1.75	2.88	5.38	–	2.25
37. "	203.50	168.50	17.20	.50	1.25	3.19	4.94	–	1.88
38. White Chester,	183.75	154.00	16.19	.25	1.50	2.13	3.88	1.00	2.25
39. " "	194.25	162.00	16.61	.25	1.38	2.63	4.26	1.13	3.38
40. Mixed,	207.50	172.50	16.87	.38	1.50	2.25	4.13	0.88	3.75
41. "	211.50	177.00	16.31	.38	1.25	2.50	4.13	0.88	3.63
42. Grade White Chester,	185.00	153.50	17.03	.50	0.94	4.00	5.44	1.19	1.94
43. " " "	199.00	163.00	18.09	.37	1.31	3.31	4.99	–	1.63
44. " " "	188.50	151.00	19.89	.44	1.13	3.56	5.13	1.25	1.94
45. " " "	200.00	162.00	19.00	.63	1.44	4.13	6.20	1.38	1.88
46. Mixed,	182.00	145.50	20.05	.56	1.50	3.69	5.75	1.50	2.81
47. "	177.00	141.00	20.34	.44	0.88	3.13	4.45	1.56	3.00
48. "	197.50	159.00	19.49	.53	1.38	3.50	5.41	1.50	1.50

Summary.

	Average Weight (Pounds).	Number of Pigs, averaged.
Live weight,	201.23	48
Dressed weight,	165.11	48
Per cent. of live weight lost by dressing,	17.95	48
Heart,	.50	32
Lungs,	1.26	32
Liver,	3.15	32
Heart, lungs and liver,	4.99	48
Stomach (empty),	1.30	26
Intestinal fat,	3.26	48

The intestinal fat, as may be seen from the preceding statement, varies from 1.75 to 6.00 pounds; its deposition, as a rule, has rapidly increased after the animals pass above 180 to 200 pounds of live weight.

Tenth Feeding Experiment (1889).

[Skim-milk, barley meal, wheat bran and gluten meal.]

The general course pursued in the management of this experiment is essentially the same as that adopted in the preceding ones (VII., VIII. and IX.). The main alteration consists in the circumstance that barley meal has been substituted for corn meal in the daily diet of the animals on trial.

Seven pigs, grades of White Chester and Berkshire, weighing from 14 to 23 pounds each at the beginning, served for our observation. The experiment began April 23, and closed August 28, lasting thus 127 days. The live weight gained during that period varied in case of different animals from 162 to 178¾ pounds. The average live weight gained of the whole lot was 169½ pounds per head, or 1.33 pounds per day. The amount of skim-milk consumed daily per head remained practically the same, after the first week, — five quarts. To every quart of milk required were added two ounces of barley meal. The additional feed subsequently needed consisted of a mixture of two weight parts of gluten meal and one of wheat bran. At the close of the second month of our trial, when the live weights of the various animals amounted to from 120 to 130 pounds each, the diet

was changed; a mixture of four weight parts of barley meal and one weight part each of gluten meal and wheat bran was fed with the original quantity of skim-milk, — five quarts daily per head. The subsequent tabular statement shows more in detail the changes in the quantities of the daily fodder rations, and also their nutritive character at different stages of growth. The entire experiment might be divided practically into three feeding periods: —

	Live Weight.	Nutritive Ratio.
Period I.,	20 to 90 pounds.	1:2.95
Period II.,	90 to 130 pounds.	1:4 20
Period III.,	130 to 200 pounds.	1:4.61

Average of Daily Rations (Experiment X.).

	Barley Meal (Ounces).	Skim-milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio.
1889.						
April 23 to May 1,	6.	3.	–	–	I.	1:2.90
May 2 to May 13,	10.	5.	–	–		
May 14 to May 28,	11.	5.5	4.00	8.00	II.	1:2.99
May 29 to June 4,	10.	5.	7.00	14.00		
June 5 to June 17,	10.	5.	11.90	23.80		
June 18 to July 8,	37.80	5.	9.47	9.47	III.	1:4.12
July 9 to July 22,	47.60	5.	11.90	11.90		
July 23 to Aug. 12,	58.80	5.	9.80	9.80	IV.	1:4.61
Aug. 13 to Aug. 27,	64.20	5.	10.70	10.70		

The amount of dry vegetable matter of the feed consumed per pound of dressed pork produced varies in case of different animals from 3.40 to 3.81 pounds, the mean being 3.6 pounds. This result is less favorable than those obtained in our ninth experiment, where the amount of dry vegetable matter consumed per pound of dressed pork obtained was noticed to vary from 2.61 to 3.17 pounds, with an average amount of 2.98 pounds. As both experiments were con-

ducted during the same period of the year, — summer season, — the results apparently point towards a higher nutritive effect of the corn meal, as compared with that of barley meal, under conditions like ours. The final decision in this direction will be left to further trials.

The higher market price of the barley meal, as compared with that of corn meal, at present market rates, is an additional cause of a less favorable financial result than in most of our late experiments, from VI. to IX. inclusive. The average net cost per pound of dressed pork, in our tenth experiment, amounted to 4.29 cents. We received 5¾ cents per pound. For more details, see farther on.

Market Cost of Fodder Articles used.

Barley meal,	$30.00 per ton.	Wheat bran,	$18.50 per ton.
Skim-milk,	1.8 cts. per gal.	Gluten meal,	$22.00 per ton.

Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

[Per cent.]

	Barley Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture,	12.90	89.78	10.92	10.19
Nitrogen,	1.507	.52	2.447	4.230
Phosphoric acid,	.664	.19	2.900	.392
Potassium oxide,	.342	.20	1.637	.049
Valuation per 2,000 pounds,	$6 23	$2 17	$13 27	$14 90

(1)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13,	11.63	93.00	–	–	1:2.90	23.00	41.50	14
May 14 to June 17,	23.62	189.00	18.69	37.38	1:2.99	41.50	88.50	1 5
June 18 to July 22,	95.64	175.00	23.91	23.91	1:4.17	88.50	135.00	1 5
July 23 to Aug. 28,	133.08	184.00	22.18	22.18	1:4.56	135.00	185.00	1 6

Total Amount of Feed consumed from April 23 to August 28.

263.97 pounds barley meal, equal to dry matter, . .	229.92 pounds.
641.00 quarts skim-milk, equal to dry matter, . .	142.16 pounds.
64.78 pounds wheat bran, equal to dry matter, . .	57.71 pounds.
83.47 pounds gluten meal, equal to dry matter, . .	74.96 pounds.
Total amount of dry matter, ...	504.75 pounds.

Live weight of animal at beginning of experiment, .	23.00 pounds.
Live weight of animal at time of killing, . . .	185.00 pounds.
Live weight gained during experiment, ...	162.00 pounds.
Dressed weight at time of killing, ...	153.50 pounds.
Loss in weight by dressing, . .	31.50 pounds, or 17.03 per cent.
Dressed weight gained during experiment, . . .	134.41 pounds.

Cost of Feed consumed during Experiment.

263.97 pounds barley meal, at $30.00 per ton, ...	$3 96
160.25 gallons skim-milk, at 1.8 cents per gallon, . . .	2 88
64.78 pounds wheat bran, at $18.50 per ton, ...	60
83.47 pounds gluten meal, at $22.00 per ton, ...	92
	$8 36

3.12 pounds of dry matter fed yielded 1 pound of live weight, and 3.76 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.22 cents.

(2)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period. lb.	oz.
1889.								lb.	oz.
April 23 to May 13, .	11.63	93.00	–	–	1 : 2.90	25.25	45.00		15
May 14 to June 17, .	23.62	189.00	18.75	37.50	1 : 2.99	45.00	94.00	1	6
June 18 to July 22, .	87.36	175.00	21.84	21.84	1 : 4.09	94.00	142.50	1	6
July 23 to Aug. 28, .	137.88	184.00	22.98	22.98	1 : 4.60	142.50	199.50	1	8

Total Amount of Feed consumed from April 23 to August 28.

260.49 pounds barley meal, equal to dry matter, . .	226.89 pounds.
641.00 quarts skim-milk, equal to dry matter, . .	142.16 pounds.
63.57 pounds wheat bran, equal to dry matter, . .	56.63 pounds.
82.32 pounds gluten meal, equal to dry matter, . .	73.93 pounds.
Total amount of dry matter, ...	499.61 pounds.

Live weight of animal at beginning of experiment,	25.25 pounds.
Live weight of animal at time of killing,	199.00 pounds.
Live weight gained during experiment,	173.75 pounds.
Dressed weight at time of killing,	163.00 pounds.
Loss in weight by dressing,	36.00 pounds, or 18.09 per cent.
Dressed weight gained during experiment,	142.32 pounds.

Cost of Feed consumed during Experiment.

260.49 pounds barley meal, at $30.00 per ton,	$3 91
160.25 gallons skim-milk, at 1.8 cents per gallon,	2 88
63.57 pounds wheat bran, at $18.50 per ton,	59
82.32 pounds gluten meal, at $22.00 per ton,	91
	$8 29

2.88 pounds of dry matter fed yielded 1 pound of live weight, and 3.51 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.82 cents.

(3)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13,	11.63	93.00	–	–	1:2.90	19.75	38.50	14
May 14 to June 17,	23.40	187.00	15.87	31.76	1:2.99	38.50	84.00	1 5
June 18 to July 22,	84.88	175.00	21.22	21.22	1:4.06	84.00	127.50	1 4
July 23 to Aug. 28,	139.60	184.00	23.27	23.27	1:4.61	127.50	188.50	1 10

Total Amount of Feed consumed from April 23 to August 28.

259.51 pounds barley meal, equal to dry matter,	226.03 pounds.
639.00 quarts skim-milk, equal to dry matter,	141.71 pounds.
60.36 pounds wheat bran, equal to dry matter,	53.77 pounds.
76.25 pounds gluten meal, equal to dry matter,	68.48 pounds.
Total amount of dry matter,	489.99 pounds.

Live weight of animal at beginning of experiment,	19.75 pounds.
Live weight of animal at time of killing,	188.50 pounds.
Live weight gained during experiment,	168.75 pounds.
Dressed weight at time of killing,	151.00 pounds.
Loss in weight by dressing,	37.50 pounds, or 19.89 per cent.
Dressed weight gained during experiment,	135.19 pounds.

Cost of Feed consumed during Experiment.

259.51 pounds barley meal, at $30.00 per ton,	$3 89
159.75 gallons skim-milk, at 1.8 cents per gallon,	2 88
60.36 pounds wheat bran, at $18.50 per ton,	56
76.25 pounds gluten meal, at $22.00 per ton,	84
	$8 17

2.90 pounds of dry matter fed yielded 1 pound of live weight, and 3.62 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.04 cents.

(4)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 23 to May 13,	11.63	93.00	–	–	1 : 2.90	23.00	42.00	14
May 14 to June 17,	23.62	189.00	18.06	36.12	1 : 2.99	42.00	92.00	1 7
June 18 to July 22,	89.64	175.00	22.41	22.41	1 : 4.11	92.00	139 50	1 6
July 23 to Aug. 28,	141.42	184.00	23.57	23.57	1 : 4.62	139.50	200.00	1 10

Total Amount of Feed consumed from April 23 to August 28.

266.31 pounds barley meal, equal to dry matter,	231.96 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
64.04 pounds wheat bran, equal to dry matter,	57.05 pounds.
82.10 pounds gluten meal, equal to dry matter,	73.73 pounds.
Total amount of dry matter,	504.90 pounds.

Live weight of animal at beginning of experiment,	23.00 pounds.
Live weight of animal at time of killing,	200.00 pounds.
Live weight gained during experiment,	177.00 pounds.
Dressed weight at time of killing,	162.00 pounds.
Loss in weight by dressing,	38.00 pounds, or 19.00 per cent.
Dressed weight gained during experiment,	143.37 pounds.

Cost of Feed consumed during Experiment.

266.31 pounds barley meal, at $30.00 per ton,	$3 99
160.25 gallons skim-milk, at 1 8 cents per gallon,	2 88
64.04 pounds wheat bran, at $18.50 per ton,	59
82.10 pounds gluten meal, at $22.00 per ton,	91
	$8 37

2.85 pounds of dry matter fed yielded 1 pound of live weight, and 3.52 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.84 cents.

(5)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13,	5.75	46.00	–	–	1 : 2.90	18.50	30.50	14
May 14 to June 17,	21.88	175.00	17.38	34.75	1 : 2.99	30.50	83.00	1 8
June 18 to July 22,	96.36	175.00	24.09	24.09	1 : 4.17	83.00	135.75	1 8
July 23 to Aug. 28,	146.52	184.00	24.42	24.42	1 : 4.65	135.75	182.00	1 4

Total Amount of Feed consumed from April 30 to August 28.

270.51 pounds barley meal, equal to dry matter,	235.61 pounds.
580.00 quarts skim-milk, equal to dry matter,	128.63 pounds.
65.89 pounds wheat bran, equal to dry matter,	58.69 pounds.
83.26 pounds gluten meal, equal to dry matter,	74.78 pounds.
Total amount of dry matter,	497.71 pounds.

Live weight of animal at beginning of experiment,	18.50 pounds.
Live weight of animal at time of killing,	182.00 pounds.
Live weight gained during experiment,	163.50 pounds.
Dressed weight at time of killing,	145.50 pounds.
Loss in weight by dressing,	36.50 pounds, or 20.05 per cent.
Dressed weight gained during experiment,	130.72 pounds.

Cost of Feed consumed during Experiment.

270.51 pounds barley meal, at $30.00 per ton,	$4 06
145.00 gallons skim-milk, at 1.8 cents per gallon,	2 61
65.89 pounds wheat bran, at $18.50 per ton,	61
83.26 pounds gluten meal, at $22.00 per ton,	92
	$8 20

3.04 pounds of dry matter fed yielded 1 pound of live weight, and 3.81 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.27 cents.

(6)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13,	5.75	46.00	–	–	1:2.90	14.00	25.75	13
May 14 to June 17,	21.88	175.00	13.13	26.25	1:2.98	25.75	71.50	1 5
June 18 to July 22,	89.55	175.00	22.37	22.37	1:4.11	71.50	121.00	1 7
July 23 to Aug. 28,	140.46	184.00	23.41	23.41	1:4.61	121.00	177.00	1 8

Total Amount of Feed consumed from April 30 to August 28.

257.59 pounds barley meal, equal to dry matter,	224.36 pounds.
580.00 quarts skim-milk, equal to dry matter,	128.63 pounds.
58.91 pounds wheat bran, equal to dry matter,	52.48 pounds.
72 03 pounds gluten meal, equal to dry matter,	64.69 pounds.
Total amount of dry matter,	470.16 pounds.

Live weight of animal at beginning of experiment,	14.00 pounds.
Live weight of animal at time of killing,	177.00 pounds.
Live weight gained during experiment,	163.00 pounds.
Dressed weight at time of killing,	141.00 pounds.
Loss in weight by dressing,	36.00 pounds, or 20.34 per cent.
Dressed weight gained during experiment,	129.85 pounds.

Cost of Feed consumed during Experiment.

257.59 pounds barley meal, at $30.00 per ton,	$3 86
145.00 gallons skim-milk, at 1.8 cents per gallon,	2 61
58.91 pounds wheat bran, at $18.50 per ton,	54
72.03 pounds gluten meal, at $22.00 per ton,	79
	$7 80

2.88 pounds of dry matter fed yielded 1 pound of live weight, and 3.62 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.01 cents.

(7)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13,	5.75	46.00	–	–	1:2.90	18.75	30.25	13
May 14 to June 17,	21.88	175.00	16.44	32.88	1:2.99	30.25	79.75	1 7
June 18 to July 22,	96.12	175.00	24.03	24.03	1:4.17	79.75	134.50	1 9
July 23 to Aug. 28,	141.84	184.00	23.64	23.64	1:4.62	134.50	197.50	1 11

Total Amount of Feed consumed from April 30 to August 28.

265.59 pounds barley meal, equal to dry matter,	231.33 pounds.
580.00 quarts skim-milk, equal to dry matter,	128.63 pounds.
64.11 pounds wheat bran, equal to dry matter,	57.11 pounds.
80.55 pounds gluten meal, equal to dry matter,	72.34 pounds.
Total amount of dry matter,	489.41 pounds.

Live weight of animal at beginning of experiment,	18.75 pounds.
Live weight of animal at time of killing,	197.50 pounds.
Live weight gained during experiment,	178.75 pounds.
Dressed weight at time of killing,	159.00 pounds.
Loss in weight by dressing,	38.50 pounds, or 19.49 per cent.
Dressed weight gained during experiment,	143.91 pounds.

Cost of Feed consumed during Experiment.

265.59 pounds barley meal, at $30.00 per ton,	$3 98
145.00 gallons skim-milk, at 1.8 cents per gallon,	2 61
64.11 pounds wheat bran, at $18.50 per ton,	59
80.55 pounds gluten meal, at $22.00 per ton,	89
	$8 07

2.74 pounds of dry matter fed yielded 1 pound of live weight, and 3.40 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.61 cents.

Summary of Experiment (X.).

	Barley Meal (Pounds).	Skim-milk (Gallons).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	LiveWeight gained during Experiment (Pounds).	Dressed Weight gained during Experiment (Pounds).	Cost per Pound of Dressed Pork (Cents).
1, ...	263.97	160.25	64.78	83.47	162.00	134.41	6.22
2, ...	260.49	160.25	63.57	82.32	173.75	142.32	5.82
3, ...	259.51	159.75	60.36	76.25	168.75	135.19	6 04
4, ...	266.31	160.25	64.04	82.10	177.00	143.37	5.84
5, ...	270.51	145.00	65.89	83.26	163.50	130.72	6.27
6, ...	257.59	145.00	58.91	72.03	163.00	129.85	6.01
7, ...	265.59	145.00	64.11	80.55	178.75	143.91	5.61
	1,843.97	1,075.50	441.66	559.98	1,186.75	959.77	–

Total Cost of Feed consumed during the Above-stated Experiment.

1,843.97 pounds barley meal, at $30.00 per ton, ...	$27 66
1,075.50 gallons skim-milk, at 1.8 cents per gallon, . . .	19 36
441.66 pounds wheat bran, at $18.50 per ton, ...	4 08
559.98 pounds gluten meal, at $22.00 per ton, ...	6 16
	$57 26

Average cost of feed for production of 1 pound of dressed pork, 5.97 cents.

Manurial Value of Feed consumed during the Above-stated Experiment.

Barley Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
$5 74	$10 13	$2 93	$4 17	$22 97

Manurial value of feed for production of 1 pound of dressed pork, 2.39 cents.

Net cost of feed for the production of 1 pound of dressed pork, 4.29 cents.

Barley Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.90	258.00	–	–	1:8.81
Dry matter, . . .	87.00	1,742.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	2.30	46.00	–	–	
" cellulose, . . .	7.11	142.20	17.06	12	
" fat, ...	1.94	38.80	26.38	68	
" protein (nitrogenous matter), . .	10.80	216.00	168.48	78	
Non-nitrogenous extract matter, ...	77.85	1,557.00	1,401.30	90	
	100.00	2,000.00	1,613.22	–	

Skim-milk (Average).

[One quart equals 2.17 pounds.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	89.78	1,795.60	–	–	1:2.13
Dry matter, . . .	10.22	204.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.85	137.00	–	–	
" cellulose, . . .	–	–	–	–	
" fat, ...	3.82	76.40	76.40	100	
" protein (nitrogenous matter), . .	31.60	632.00	632.00	100	
Non-nitrogenous extract matter, ...	57.73	1,155.60	1,155.60	100	
	100.00	2,000.00	1,864.00	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.92	218.40	–	–	1 : 3.99
Dry matter,	89.08	1,781.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.00	140.00	–	–	
" cellulose,	11.52	230.40	46.08	20	
" fat,	5.43	108.60	86.88	80	
" protein (nitrogenous matter),	17.17	343.40	302.19	88	
Non-nitrogenous extract matter,	58.88	1,177.60	942.08	80	
	100.00	2,000.00	1,377.23	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.19	203.80	–	–	1 : 2.86
Dry matter,	89.81	1,796.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.57	11.40	–		
" cellulose,	.56	11.20	3.81	34	
" fat,	6.40	128.00	97.28	76	
" protein (nitrogenous matter),	29.45	589.00	500.65	85	
Non-nitrogenous extract matter,	63.02	1,260.40	1,184.78	94	
	100.00	2,000.00	1,786.52	–	

VI. Fodder Analyses. (1889.)

The majority of the analyses stated under the above heading are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

In presenting these analyses, it seems but proper to call the attention of farmers once more forcibly to a careful consideration of the following facts.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind after it has served its purpose as a constituent of the food consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

The higher or lower commercial value of the manurial refuse left behind after the feed has accomplished its purpose in a satisfactory degree, decides its actual or net cost in farm industry. A disregard of this circumstance renders, in many instances, a remunerative dairying not less doubtful than a profitable feeding of live stock for the meat market.

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	16.44	328.80	–	–	1 : 7.92
Dry matter,	83.56	1,671.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.02	40.40	–	–	
" cellulose,	2.09	41.80	14.21	34	
" fat,	3.47	69.40	52.74	76	
" protein (nitrogenous matter),	12.27	245.40	208.69	85	
Non-nitrogenous extract matter,	80.15	1,603.00	1,506.82	94	
	100.00	2,000.00	1,782.46	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.13	242.60	–	–	1 : 9.68
Dry matter,	87.87	1,757.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.46	29.20	–	–	
" cellulose,	1.79	35.80	12.17	34	
" fat,	4.36	87.20	66.27	76	
" protein (nitrogenous matter),	10.44	208.80	177.48	85	
Non-nitrogenous extract matter,	81.95	1,639.00	1,540.66	94	
	100.00	2,000.00	1,796.58	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.71	214.20	–	–	1 : 10
Dry matter,	89.29	1,785.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.00	20.00	–	–	
" cellulose,	1.74	34.80	11.83	34	
" fat,	4.22	84.40	64.14	76	
" protein (nitrogenous matter),	10.19	203 80	173.23	85	
Non-nitrogenous extract matter,	82.85	1,657.00	1,557.60	94	
	100.00	2,000 00	1,806.80	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.98	239.60	–	–	1 : 8.47
Dry matter,	88.02	1,760.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.56	31.20	–	–	
" cellulose,	1.85	37.00	12.58	34	
" fat,	4.69	93.80	71.29	76	
" protein (nitrogenous matter),	11.79	235.80	200.43	85	
Non-nitrogenous extract matter,	80.11	1,602.20	1,506.07	94	
	100.00	2,000.00	1,790.37	–	

Corn Meal.

[Amherst Mill.]

92.34 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.36	–	–	–	1 : 9.17
Dry matter,	86.64	–	–	–	
	100.00	–	–	–	
Analysis of Dry Matter.					
Crude ash,	1.28	25.60	–	–	
" cellulose,	2.28	45.60	15.50	34	
" fat,	3.18	63.60	48.34	76	
" protein (nitrogenous matter),	10.82	216.40	183.94	85	
Non-nitrogenous extract matter,	82.44	1,648.80	1,549.87	94	
	100.00	2,000.00	1,797.65	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.51	310.20	–	–	1 : 8.54
Dry matter,	84.49	1,689.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.60	32.00	–	–	
" cellulose,	1.74	34.80	11.83	34	
" fat,	4.54	90.80	69.01	76	
" protein (nitrogenous matter),	11.69	233.80	198.73	85	
Non-nitrogenous extract matter,	80.43	1,608.60	1,512.08	94	
	100.00	2,000.00	1,791.65	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.32	226.40	–	–	1 : 9.89
Dry matter, . . .	88.68	1,773.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.53	30.60	–	–	
" cellulose, . . .	1.20	24.00	8.16	34	
" fat, ...	4.30	86.00	65.36	76	
" protein (nitrogenous matter), . .	10.26	205 20	174.42	85	
Non-nitrogenous extract matter, ...	82.71	1,654.20	1,554.95	94	
	100.00	2,000.00	1,802.89	–	

Corn Meal.

[Amherst Mill.]

88.50 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.05	201.00	–	–	1 : 9.14
Dry matter, . . .	89.95	1,799.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.63	32.60	–	–	
" cellulose, . . .	1.34	26.80	9.11	34	
" fat, ...	4.18	83.60	63.54	76	
" protein (nitrogenous matter), . .	10.98	219.80	186.66	85	
Non-nitrogenous extract matter, ...	81.87	1,637.40	1,539.15	94	
	100.00	2,000.00	1,798.46	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.57	191 40	–	–	1 : 4.06
Dry matter,	90.43	1,808.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.90	118.00	–	–	
" cellulose,	10.08	201.60	40.32	20	
" fat,	4.78	95.60	76.48	80	
" protein (nitrogenous matter),	17.06	341.20	302.26	88	
Non-nitrogenous extract matter,	62.18	1,243.60	994.88	80	
	100.00	2,000.00	1,413.94	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.34	226.80	–	–	1 : 3.70
Dry matter,	88.66	1,773 20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.56	131.20	–	–	
" cellulose,	11.27	225.40	45.08	20	
" fat,	4.64	92.80	74.24	80	
" protein (nitrogenous matter),	18.13	362.60	319.09	88	
Non-nitrogenous extract matter,	59.40	1,188.80	950.40	80	
	100.00	2,000.00	1,388.81	–	

Wheat Bran.

[Amherst Mill.]

40.11 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.34	186.80	–	–	1 : 3.63
Dry matter,	90.66	1,813.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.67	133.40	–	–	
" cellulose,	10.88	217.60	43.52	20	
" fat,	3.59	71.80	57.44	80	
" protein (nitrogenous matter),	18.13	362.60	319.09	88	
Non-nitrogenous extract matter,	60.73	1,214.60	971.68	80	
	100.00	2,000.00	1,391.73	–	

Wheat Bran.

[Amherst Mill.]

19.56 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.41	208.20	–	–	1 : 4.08
Dry matter,	89.59	1,791.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.99	139.80	–	–	
" cellulose,	12.02	240.40	48.08	20	
" fat,	5.46	119.20	95.36	80	
" protein (nitrogenous matter),	17.02	340.40	299.55	88	
Non-nitrogenous extract matter,	58.51	1,170.20	936.16	80	
	100.00	2,000.00	1,379.15	–	

Wheat Bran.

[Amherst Mill.]

17.97 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.42	228.40	–	–	1 : 3.97
Dry matter,	88.58	1,771.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.00	140.00	–	–	
" cellulose,	11.03	220.60	44.12	20	
" fat,	5.40	108.00	86.40	80	
" protein (nitrogenous matter),	17.31	346.20	304.66	88	
Non-nitrogenous extract matter,	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,383.34	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.85	177.00	–	–	1 : 4.23
Dry matter,	91.15	1,823.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.54	150.80	–	–	
" cellulose,	9.64	192.80	38.56	20	
" fat,	5.16	103.20	82.52	80	
" protein (nitrogenous matter),	16.45	329.00	289.52	88	
Non-nitrogenous extract matter,	61.21	1,224.20	979.36	80	
	100.00	2,000.00	1,389.96	–	

Wheat Bran.

[I. sent on by T. P. Root, Barre, Mass.; II. and III. sent on by E. D. Gibson, Ashburnham, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	8.10	11.36	11.64
Dry matter,	91.90	88.64	88.36
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.89	6.98	7.42
" cellulose,	10.73	5.95	5.60
" fat,	5.40	7.49	9.43
" protein (nitrogenous matter),	16.73	17.97	16.13
Non-nitrogenous extract matter,	60 25	61.61	61.42
	100.00	100.00	100.00
Passed screen 144 meshes to square inch,	29.57	24.89	16.03

Gluten Meal.

[Springfield, Mass]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.49	189.80	–	–	1 : 2.84
Dry matter,	90.51	1,810.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.04	.80	–	–	
" cellulose,	.27	5.40	1 84	34	
" fat,	6.69	133.80	101.69	76	
" protein (nitrogenous matter),	29.87	597.40	507.79	85	
Non-nitrogenous extract matter,	63.13	1,262.60	1,186.84	94	
	100.00	2,000.00	1,798.16	–	

Gluten Meal.

[Springfield, Mass.]

50.24 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.50	210.00	–	–	1 : 2.93
Dry matter,	89 50	1,790.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.34	6.80	–	–	
" cellulose,	.41	8.20	2.79	34	
" fat,	7.08	141.60	107.62	76	
" protein (nitrogenous matter),	29.19	583.80	496.23	85	
Non-nitrogenous extract matter,	62.98	1,259.60	1,184.02	94	
	100.00	2,000.00	1,790.66	–	

Gluten Meal.

[Springfield, Mass.]

56.14 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.29	225.80	–	–	1 : 2.59
Dry matter,	88.71	1,774 20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.73	14.60	–	–	
" cellulose,	.69	13.80	4.69	34	
" fat,	4.08	81.60	62.02	76	
" protein (nitrogenous matter),	30.86	617.20	524.62	85	
Non-nitrogenous extract matter,	63.64	1,272.80	1,196.43	94	
	100.00	2,000.00	1,787.76	–	

Gluten Meal.

[Springfield, Mass.]

51.93 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.89	197.80	–	–	1 : 2.79
Dry matter,	90.11	1,802.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.79	15.80	–	–	
" cellulose,	.71	14.20	4.83	34	
" fat,	5.72	114.40	86.94	76	
" protein (nitrogenous matter),	29.73	594.40	505.24	85	
Non-nitrogenous extract matter,	63.06	1,261.20	1,185.53	94	
	100.00	2,000.00	1,782.54	–	

Gluten Meal.

[Sent on from Boston, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.85	157.00	–	–	1 : 1.99
Dry matter,	92.15	1,843.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.82	36.40	–	–	
" cellulose,	1.61	32.20	10.95	34	
" fat,	17.36	347 20	263.87	76	
" protein (nitrogenous matter),	41.10	822.00	698.70	85	
Non-nitrogenous extract matter,	38.11	762.20	716.47	94	
	100.00	2,000.00	1,689.99	–	

Gluten Meal.

[Sent on by W. H. Fairbanks, Sudbury, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.62	192.40	–	–	1 : 3.63
Dry matter,	90.38	1,807.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.95	19.00	–	–	
" cellulose,	4.26	85.20	28.97	34	
" fat,	7.82	156.40	118.86	76	
" protein (nitrogenous matter),	24.34	486.80	413.78	85	
Non-nitrogenous extract matter,	62.63	1,252.60	1,177.44	94	
	100.00	2,000.00	1,739.05	–	

Gluten Meal.

[Springfield, Mass.]

44.59 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.80	196.00	–	–	1 : 2.58
Dry matter,	90.92	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.25	25.00	–	–	
" cellulose,	1.75	35.00	11.90	34	
" fat,	7.00	140 00	106.40	76	
" protein (nitrogenous matter),	31.25	625.00	551.25	85	
Non-nitrogenous extract matter,	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,774.05	–	

Old Process Linseed Meal.

[Springfield, Mass.]

75.52 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.46	209.20	–	–	1 : 1.63
Dry matter,	89.54	1,790.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.08	141.60	–	–	
" cellulose,	8.51	170.20	44.25	26	
" fat,	7.98	159.60	145.24	91	
" protein (nitrogenous matter),	38.67	773.40	671.86	87	
Non-nitrogenous extract matter,	37.76	755.20	687.23	91	
	100.00	2,000.00	1,548.58	–	

Old Process Linseed Meal (Fine).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.48	149.60	–	–	1 : 1 76
Dry matter,	92.52	1,850.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.67	113.40	–	–	
" cellulose,	8.04	16.08	41.80	26	
" fat,	7.40	148.00	134.68	91	
" protein (nitrogenous matter),	37.15	743.00	646.41	87	
Non-nitrogenous extract matter,	41.74	834.80	759.67	91	
	100.00	2,000.00	1,582,56	–	

Fertilizing Constituents of Old Process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	7.480
Calcium oxide,	.671
Magnesium oxide,	.827
Ferric oxide,	.060
Potassium oxide (4¼ cents per pound),	1.379
Phosphoric acid (6 cents per pound),	1.548
Nitrogen (17 cents per pound),	5.508
Insoluble matter,	.214
Valuation per ton,	$21 76

New Process Linseed Meal (Coarse).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.01	120.20	–	–	1 : 1.32
Dry matter,	93.99	1,879.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.04	120.80	–	–	
" cellulose,	9.23	184.60	48.00	26	
" fat,	3.14	62.80	57.15	91	
" protein (nitrogenous matter),	40.76	815.20	709.22	87	
Non-nitrogenous extract matter,	40.83	816.60	743.11	91	
	100.00	2,000.00	1,557.48	–	

Fertilizing Constituents of New Process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	6.010
Calcium oxide,	.552
Magnesium oxide,	.534
Ferric oxide,	.047
Potassium oxide (4¼ cents per pound),	1.517
Phosphoric acid (6 cents per pound),	1.651
Nitrogen (17 cents per pound),	6.112
Insoluble matter,	.192
Valuation per ton,	$24 05

Linseed Meal.

[I., new process, sent on by T. P. Root, Barre, Mass.; II., old process, sent on by S. P. Puffer, North Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.58	10.43
Dry matter,	91.42	89.57
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.52	8.37
" cellulose,	10.31	9.69
" fat,	3.18	6 24
" protein (nitrogenous matter),	32.50	30.98
Non-nitrogenous extract matter,	46.49	44.72
	100.00	100.00

Fine Feed.

[Sent on by T. P. Root, Barre, Mass.]

	Per Cent.
Moisture at 100° C.,	7.76
Dry matter,	92.24
	100.00
Analysis of Dry Matter.	
Crude ash,	4.60
" cellulose,	5.81
" fat,	5.59
" protein (nitrogenous matter),	21.58
Non-nitrogenous extract matter,	62.42
	100.00

Barley Meal.

[Springfield, Mass.]

77.86 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.19	243.80	–	–	1 : 8.53
Dry matter,	87.81	1,756.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.82	36.40	–	–	
" cellulose,	7.37	147.40	17.69	12	
" fat,	2.19	43.80	29.78	68	
" protein (nitrogenous matter),	11.17	223.40	174.25	78	
Non-nitrogenous extract matter,	77.45	1,549.00	1,394.10	90	
	100.00	2,000.00	1,615.82	–	

Barley Meal.

[Springfield, Mass.]

57.71 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.61	272.20	–	–	1 : 9.11
Dry matter,	86.39	1,727.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.79	55.80	–	–	
" cellulose,	6.85	137.00	16.44	12	
" fat,	1.69	33.80	22.95	68	
" protein (nitrogenous matter),	10.42	208.40	162.55	78	
Non-nitrogenous extract matter,	78.25	1,565.00	1,408.50	90	
	100.00	2,000.00	1,610.44	–	

White Soja Beans.

[Bought in New York.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.85	117.00	–	–	1 : 1.97
Dry matter,	94.15	1,883.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.57	111.40	–	–	
" cellulose,	5.15	103.00	14.94	14.5	
" fat,	18 42	368.40	330.82	89.8	
" protein (nitrogenous matter),	35.98	719.60	647.64	90.0	
Non-nitrogenous extract matter,	34.88	697.60	432.51	62.0	
	100.00	2,000.00	1,425.91	–	

White Soja Beans.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	17.38	347.60	–	–	1 : 2.37
Dry matter,	82.62	1,652.40	–	–	
	100 00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.22	104.40	–	–	
" cellulose,	5.35	107 00	15.52	14.5	
" fat,	21.89	437.80	393.74	89.8	
" protein (nitrogenous matter),	33.36	667.20	600.48	90.0	
Non-nitrogenous extract matter,	34.18	683.60	423.83	62.0	
	100.00	2,000.00	1,432.97	–	

Fertilizing Constituents of White Soja Beans.

	Per Cent.
Moisture at 100° C,	17.380
Calcium oxide,	.342
Magnesium oxide,	.869
Ferric oxide,	.231
Sodium oxide,	.166
Potassium oxide (4¼ cents per pound),	2.085
Phosphoric acid (6 cents per pound),	1.851
Nitrogen (17 cents per pound),	4.409
Insoluble matter,	.090
Valuation per ton,	$18 98

Black Soja Beans.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.27	385.40	–	–	1 : 2.28
Dry matter,	80.73	1,614.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.73	134.60	–	–	
" cellulose,	7.57	151.40	21.95	14 5	
" fat,	20.25	405.00	363.69	89.8	
" protein (nitrogenous matter),	32.58	651.60	586.44	90.0	
Non-nitrogenous extract matter,	32.87	657.40	407.59	62.0	
	100.00	2,000.00	1,379.67	–	

Fertilizing Constituents of Black Soja Beans.

	Per Cent.
Moisture at 100° C.,	19.270
Calcium oxide,	.495
Magnesium oxide,	.949
Ferric oxide,	.201
Sodium oxide,	.384
Potassium oxide (4¼ cents per pound),	1.896
Phosphoric acid (6 cents per pound),	1.886
Nitrogen (17 cents per pound),	4.208
Insoluble matter,	.095
Valuation per ton,	$18 18

Corn "Husks" or "Chaff."

[Sent on by C. Brigham & Co., Northborough, Mass.]

	Per Cent.
Moisture at 100° C.,	13.26
Dry matter,	86.74
	100.00

Analysis of Dry Matter.

Crude ash,	2.76
" cellulose,	18.91
" fat,	1.61
" protein (nitrogenous matter),	5.61
Non-nitrogenous extract matter,	71.11
	100.00

1.55 per cent. passed screen 144 meshes to square inch.

Corn "Germs."

[Sent on by C. Brigham & Co., Northborough, Mass.]

	Per Cent.
Moisture at 100° C.,	13.02
Dry matter,	86.98
	100.00

Analysis of Dry Matter.

Crude ash,	3.09
" cellulose,	2.25
" fat,	6.01
" protein (nitrogenous matter),	11.20
Non-nitrogenous extract matter,	77.45
	100.00

46.77 per cent. passed screen 144 meshes to square inch.

Low Meadow Hay.

[Sent on by S. N. Thompson, Southborough, Mass.]

	Per Cent.
Moisture at 100° C.,	8.01
Dry matter,	91.99
	100.00

Analysis of Dry Matter.

Crude ash,	6.75
" cellulose,	35.59
" fat,	1.88
" protein (nitrogenous matter),	9.51
Non-nitrogenous extract matter,	46.27
	100.00

Corn Stover.

[Sent on by J. C. Dillon, Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	15.60	17.22
Dry matter,	84.40	82.78
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	8.00	4.53
" cellulose,	38.24	28.41
" fat,	1.17	1.41
" protein (nitrogenous matter),	7.94	6.07
Non-nitrogenous extract matter,	44.65	60.08
	100.00	100.00

Ensilage.

[I. and II. sent on by J. N. Raymond, Beverly, Mass.; III. sent on by B. C. Haskell, Boston, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	80.77	78.98	79.73
Dry matter,	19.23	21.02	20.27
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	5 08	4.71	3,19
" cellulose,	33.99	33.79	28.43
" fat,	2.71	1.94	3.60
" protein (nitrogenous matter),	10.26	7.74	7.49
Non-nitrogenous extract matter,	47.96	51.82	57.29
	100.00	100.00	100.00

Barley and Oat Chaff.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.49
Dry matter,	86.51
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	10.41
" cellulose,	24.30
" fat,	2.40
" protein (nitrogenous matter),	11.78
Non-nitrogenous extract matter,	51.11
	100.00

Fertilizing Constituents of Barley and Oat Chaff.

Moisture at 100° C.,	13.490
Calcium oxide,	.853
Magnesium oxide,	.346
Ferric oxide,	.072
Sodium oxide,	.035
Potassium oxide (4¼ cents per pound),	1.146
Phosphoric acid (6 cents per pound),	.409
Nitrogen (17 cents per pound),	1.650
Insoluble matter,	.272
Valuation per ton,	$7 07

Soja Bean (Entire Plant).

[Collected Aug. 26, 1889.]

	Per Cent.
Moisture at 100° C.,	6.48
Dry matter,	93.52
	100.00

Analysis of Dry Matter.

Crude ash,	8.55
" cellulose,	21.75
" fat,	6.35
" protein (nitrogenous matter),	15.10
Non-nitrogenous extract matter,	48.25
	100.00

In green material, moisture, 73.43 per cent.; dry matter, 26.57 per cent.

Fertilizing Constituents of Soja Bean.

Moisture at 100° C.,	6.480
Calcium oxide,	2.750
Magnesium oxide,	1.165
Ferric oxide,	.099
Sodium oxide,	.098
Potassium oxide (4¼ cents per pound),	1.546
Phosphoric acid (6 cents per pound),	.581
Nitrogen (17 cents per pound),	2.259
Insoluble matter,	.987
Valuation per ton,	$9 69

Spanish or Long Moss (Tillandsia usneoides).

	Per Cent.
Moisture at 100° C.,	60.80
Dry matter,	39.20
	100.00

Analysis of Dry Matter.

Crude ash,	2.67
" cellulose,	32.61
" fat,	2.54
" protein (nitrogenous matter),	4.45
Non-nitrogenous extract matter,	57.73
	100.00

Fertilizing Constituents of Spanish Moss.

Moisture at 100° C.,	60.80
Calcium oxide,	.089
Magnesium oxide,	.122
Ferric and aluminic oxides,	.029
Sodium oxide,	.263
Potassium oxide (4¼ cents per pound),	.255
Phosphoric acid (6 cents per pound),	.030
Nitrogen (17 cents per pound),	.279
Insoluble matter,	.191
Valuation per ton,	$1 21

Palmetto Root.

[Sent on by C. D. Duncan, Mandarin, Fla.]

	Per Cent.
Moisture at 100° C.,	11.51
Dry matter,	88.49
	100.00

Analysis of Dry Matter.

Crude ash,	4.44
" cellulose,	21 26
" fat,	.53
" protein (nitrogenous matter),	3.82
Non-nitrogenous extract matter,	69.95
	100.00

Starch (in dry matter),	49.84
Sugar,	Trace.
Tannin,	Trace.

Fertilizing Constituents of Palmetto Root.

Moisture at 100° C.,	11.510
Ash,	3.930
Calcium oxide,	.045

	Per Cent.
Magnesium oxide,	.004
Ferric oxide,	.017
Sodium oxide,	.345
Potassium oxide ($4\frac{1}{4}$ cents per pound),	1.380
Phosphoric acid (6 cents per pound),	.157
Nitrogen (17 cents per pound),	.540
Insoluble matter,	.410
Valuation per ton,	$3 20

Result of Examination of Fifty-pound Samples of the Corn entered by Competitors in This State for the American Agriculturist Prize.

1. Proportion of Moisture, Kernels and Cobs.

Name and Address of Competitors.	Per Cent. of Composition.			Per Cent. of Moisture.		Ratio of Cobs to Kernels.	
	Water.	Kernels	Cobs.	Kernels	Cobs.	As Received.	At 100° C.
1. W. S. Westcott, Amherst,	31.30	58.88	9.82	23.26	57.38	1 : 3.60	1 : 5.99
2. J. C. Dillon, Amherst,	40.74	52.30	6.96	33.50	67.40	1 : 3.96	1 : 7.51
3. F. Goodwin, Framingham,	32.59	59.17	8.24	29.87	46.12	1 : 4.23	1 : 7.06
4. J. S. Wells, Hatfield,	37.28	54.66	8.06	33.49	54.77	1 : 3.60	1 : 6.78
5. Henry Tillson, Sunderland,	32.02	58.46	9.52	28.75	46.96	1 : 5.61	1 : 6.17
6. G. P. Smith, Sunderland,	30.31	59.29	10.40	22.36	56.00	1 : 3.53	1 : 5.70
7. John Brooks, Princeton,	28.27	61.46	10.27	24.98	45.75	1 : 3.62	1 : 6.98
Averages,	33.22	57.74	9.03	28.15	53.48	1 : 4.02	1 : 6.69

2. Description of Ears.

Kind of Corn.	Number of Ears.	Average Weight of Ears (Grams).		Average Weight of Kernels (Grams).		Average Length of Ears (Inches).
		As Received.	At 100° C.	As Received	At 100° C.	
1. Yellow Flint,	125	177.4	121.9	.368	.281	$8\frac{3}{8}$
2. Yellow Dent,	96	222.9	132.1	.297	.197	$7\frac{2}{3}$
3. Yellow Flint,	102	209.8	141.8	.452	.317	$9\frac{7}{8}$
4. Yellow Dent,	67	319.4	200.3	.452	.300	$8\frac{1}{4}$
5. Yellow Dent,	129	173.6	118.0	.384	.273	$6\frac{3}{8}$
6. Yellow and White Flint,	115	194.7	135.7	.457	.355	$9\frac{1}{8}$
7. White Flint,	135	167.9	120.5	.415	.312	8
Averages,	110	209.4	139.9	.404	.291	$8\frac{1}{4}$

3. Fodder Constituents in Kernels (Per Cent.).

	Moisture at 100° C.	Dry Matter.	Analysis of Dry Matter.					Nutritive Ratio.
			Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	
1, ...	23.26	76.74	1.77	1.07	4.69	8.49	83.98	1:12.22
2, ...	33.50	66.50	1.65	1.40	4.42	9.37	83.16	1:10.93
3, ...	29.87	70.13	1.99	1.03	5.32	11.58	80.08	1: 8.72
4, ...	33.49	66.51	1.95	1.51	5.45	11.14	79.95	1: 9.08
5, ...	28.75	71.25	1.19	1.71	5.09	9.27	82.74	1:11.17
6, ...	22.36	77.64	1.44	1.36	4.96	13.36	78.88	1: 7.40
7, ...	24.98	75.02	2.09	1.27	5.28	12.27	79.09	1: 8.45
Averages, .	28.03	71.97	1.73	1.33	5.03	10.78	81.13	1: 9.71

Per Cent. of Digestibility of Constituents.

Crude cellulose, ...	34
" fat, ...	76
" protein, ...	85
Non-nitrogenous extract matter, ...	94

4. Fertilizing Constituents in Dry Matter (Per Cent.).

	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Sodium Oxide.	Potassium Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per 2,000 Pounds Dry Matter.
1, ...	.028	.200	.017	.033	.274	.624	1.35	.040	$5 57
2, ...	.114	.193	.054	.025	.318	.845	1.49	.032	6 35
3, ...	.036	.222	.022	.038	.349	.772	1.85	.038	7 52
4, ...	.027	.169	.015	.023	.389	.492	1.78	.018	6 67
5, ...	.026	.164	.009	.028	.342	.457	1.49	.009	5 91
6, ...	.034	.231	.041	.028	.462	.638	1.97	.013	7 86
7, ...	.022	.264	.020	.031	.407	.859	1.96	.020	8 03
Averages, . .	.041	.206	.025	.029	.363	.670	1.70	.024	$6 85

Potassium oxide, 4¼ cents per pound; phosphoric acid, 6 cents; nitrogen, 17 cents.

ON FIELD EXPERIMENTS.

I. Field experiments to compare the influence of an addition of nitrogen in different combinations to the soil under cultivation, on the general character of the crop and on the annual yield.

II. Influence of fertilizers on the quantity and quality of prominent fodder crops.

III. Experiments with field and garden crops.

IV. Experiments with green crops for summer feed of milch cows.

V. Notes on miscellaneous field work.

VI. Prof. James E. Humphrey's report on fungi, etc.

I. Field Experiments to compare the Influence of an Addition of Nitrogen in Different Combinations to the Soil under Cultivation, on the General Character of the Crop and on the Annual Yield. (Field A.)

The area assigned to this investigation is the same which has been used in preceding years to study our lands with reference to the conditions of the inherent natural resources of potash. The previous system of subdivision into plats, one-tenth of one acre in size, is retained in all its details. The record of each plat, as far as modes of cultivation and of manuring are concerned, extends over more than five successive years. This circumstance served as one of the inducements to undertake the above-stated task.

Some plats had received during that period a supply of nitrogen for manurial purposes in but one and the same specified form, while others had received none in any form. This condition of the various plats was turned to proper account in our new plans. Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes, were retained in that state to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation; while the remaining ones received, as before, a definite amount of nitrogen in the same form in which they had received it in preceding years, namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried

blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received, without an exception, a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid, and from 40 to 50 pounds of available nitrogen, were supplied per acre.

One plat, marked 0, received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate, and 18 pounds of dissolved bone-black.

Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 1 and 2 received nitrogen in form of sodium nitrate; plats 5, 6 and 8 received nitrogen in form of ammonium sulphate; plats 3 and 10 received nitrogen in form of dried blood; plat 0 received nitrogen in form of barn-yard manure.

For details, compare the following tables, containing the history of Field A: —

Composition of Manurial Substances applied.

	Per Cent.
Nitrate of soda = nitrogen,	16.00
Sulphate of ammonia = nitrogen,	20.91
Dried blood = nitrogen,	8.24
Muriate of potash = potassium oxide,	48.58
Sulphate of potash = potassium oxide,	37.54
Dissolved bone-black = available phosphoric acid,	21.80
Barn-yard manure = moisture,	73.04
phosphoric acid,	.688
potassium oxide,	.527
nitrogen,	.568

Field A.

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887, 1888, 1889, planted with "Clark" corn.]

NUMBER OF PLAT.	FERTILIZERS APPLIED.			YIELD OF DRY FODDER CORN.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1,	25 lbs. sodium nitrate (= 4 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen) and 50 lbs. muriate of potash (= 25 lbs. potassium oxide),	480	430	720
Plat 2,	Nothing,	Nothing,	Nothing,	310	250	165
Plat 3,	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen) and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid),	350	310	240
Plat 4,	Nothing,	Nothing,	Nothing,	300	250	130
Plat 5,	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen) and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide),	360	280	635
Plat 6,	Fallow,	Fallow,	Fallow,	-	-	-
Plat 7,	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. muriate of potash (= 25 lbs. potassium oxide),	280	255	730
Plat 8,	Nothing,	Nothing,	Nothing,	250	195	165
Plat 9,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	945	840	655
Plat 10,	48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen),	845	895	940

Field A — Concluded.

Number of Plat.	Fertilizers Applied. 1888.	Fertilizers Applied. 1889.	Yield of Dry Fodder Corn. 1888.	Yield of Dry Fodder Corn. 1889.
Plat 1,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	617	648
Plat 2,	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8.5 lbs. available phosphoric acid),	303	577
Plat 3,	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8.5 lbs. available phosphoric acid),	150	618
Plat 4,	Nothing,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	114	381
Plat 5,	97 lbs. magnesium sulphate,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	564	488
Plat 6,	Nothing,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	193	542
Plat 7,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	676	526
Plat 8,	50 lbs. ammonium sulphate (= 10 lbs. nitrogen),	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	146	359
Plat 9,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	553	476
Plat 10,	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	737	640

The entire field, eleven plats, was ploughed April 9. The fertilizer was applied broadcast to each plat, and subsequently slightly harrowed under, April 27. The final preparation of the soil for seeding, by ploughing and harrowing, took place May 9. The same variety of corn (Clark), a flint corn, was planted in drills in a similar manner as during preceding years, May 10. The crop on all plats was kept clean by means of the cultivator and hoe; it was cut September 3, when the kernels were fairly glazed over. The degree of progress in the growth of the corn upon different plats during the entire season may be noticed from the following tabular statement of periodical measurements of their average heights: —

Height of Corn on Plats, in Inches (1889).

	June 11.	June 19.	June 26.	July 3.	July 10.	July 17.	July 24.	July 31.	Aug. 7.	Aug. 14.	Aug. 21.	Aug. 28.
Plat 0, .	6	9	11	18	25	35	45	64	70	73	73	73
Plat 1, .	6	9	12	16	26	36	44	64	73	73	73	73
Plat 2, .	6	7½	10	15	25	33	42	62	68	70	70	72
Plat 3, .	6½	9	12	14	24	31	41	60	68	73	73	75
Plat 4, .	5½	7	10	13	20	27	33	49	62	65	65	67
Plat 5, .	5½	7½	10	13	23	34	41	55	67	70	70	70
Plat 6, .	6	8	9½	13	20	30	40	61	66	74	74	74
Plat 7, .	6	10	13	16	26	40	48	60	64	68	70	70
Plat 8, .	5	6½	8	10	17	21	30	45	54	60	62	68
Plat 9, .	6	9	10	16	22	33	41	60	63	68	69	69
Plat 10, .	7	11	14	19	27	46	54	69	75	76	76	76

The marked difference in the general appearance of the corn crop on different plats during the various stages of its growth was, however, not confined to their varying heights; they differed also at times much in regard to a more or less healthy color. The growth upon plats 7 and 9, in particular, was, during the entire season, of a light-green color; the same feature was noticeable to some degree, during the first half of the season, on plats 4, 5, 6 and 8. Upon the remaining plats the color was deep green, indicating a vigorous condition. Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 5, 6 and 8 received an addition

of nitrogen in form of ammonium sulphate, and the remaining plats in form either of dried blood or of sodium nitrate. Not less noticeable is the difference in the character of the final crop. Those plats (4, 7 and 9) which received no nitrogen in the fertilizer applied, produced not only by far the smallest quantity of ears, but also the smallest number of well-developed ears. The yield in corn stover, on the other hand, is, in two of these cases (7 and 9) at least, equal to the highest on any of the other plats, as may be seen from the following record: —

Yield of Corn Stover and Ears on Plats (1889), at Forty-eight Per Cent. Moisture.

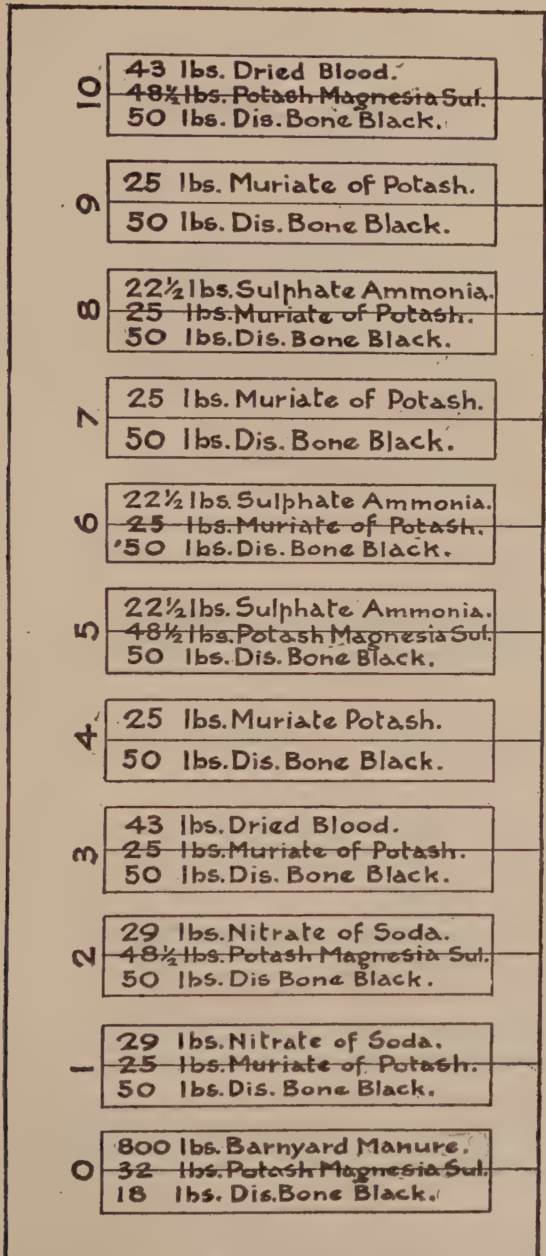
	Weight of Whole Crop.	Weight of Stover.	Weight of Ears.
	Lbs.	Lbs.	Lbs.
Plat 0, . . .	500.62	342.35	158.27
Plat 1, . . .	648.48	475.95	172.53
Plat 2, . . .	576.91	375.75	201.16
Plat 3, . . .	618.31	425.85	192.46
Plat 4, . . .	381.18	283.90	97.28
Plat 5, . . .	488.01	359.05	128.96
Plat 6, . . .	541.95	367.05	174.90
Plat 7, . . .	525.82	484.30	41 52
Plat 8, . . .	359.12	237.98	121.14
Plat 9, . . .	475.63	417.50	58.13
Plat 10, . . .	639.55	467.60	171.95

Percentage of Well-developed and Undeveloped Ears on Plats (1889).

	Well-developed Ears.	Undeveloped Ears.
	Per Cent.	Per Cent.
Plat 0, ...	60.3	39.7
Plat 1, ...	48.5	51.5
Plat 2, ...	46.7	53.3
Plat 3, ...	28.3	71.7
Plat 4, ...	14.7	85.3
Plat 5, ...	18.7	81.3
Plat 6, ...	29.0	71.0
Plat 7, ...	41.6	58.4
Plat 8, ...	21.3	78.7
Plat 9, ...	24.4	75.6
Plat 10, ...	50.2	49.8

The results of our first season of observation regarding the influence of nitrogen-containing manurial substances on the character and on the quantity of the fodder corn raised under otherwise corresponding circumstances, although not without some interest, are not decisive enough to advise a detailed explanation of causes. The larger part of the late summer season with us was cold and wet, and for this reason of an exceptionally unfavorable character for the raising of fodder corn. How much this circumstance has affected our results, is difficult to decide. Not less difficult is it to decide, at this stage of observation, how much the special conditions of various plats may yet control the results. The experiment will be continued until a reliable basis for a final conclusion has been secured.

FIELD "A" 1889.



CORN PLATS WITH DRAINAGE SYSTEM. SCALE, 4 RODS TO 1 INCH.

II. Influence of Fertilizers on the Quantity and Quality of Prominent Fodder Crops. (Field B.)

The field is located west of Field A, and has been used, like the latter, for several years previous to the establishment of the experiment station, for the production of hay. The land is nearly on a level, and runs from north to south; it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and the same amount of fertilizer, — six hundred pounds of ground bones, and two hundred pounds of muriate of potash per acre. Since 1885 all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and, in the case of grasses, two feet. The space between the different plats has received, thus far, no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 were fertilized annually; plats 12, 14, 16, 18 and 20 have received no fertilizer until the present season, — 1889.

The details of the work carried on upon Field B are from year to year recorded in the annual report of the station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins, and the reports of the succeeding year.

The subsequent tabular statement of crops raised upon the different plats of Field B since 1886 may assist in a desirable understanding of its late history, and its condition at the beginning of the season of 1889. The single plats are, since 1886, each 175 feet long and 33 feet wide.

Statement of Crops raised on Field B.

PLATS.	1887.	1888.	1889.
Plat 11 (fertilized,)	Corn,	Kentucky blue-grass (*Poa prætensis*),	Kentucky blue-grass.
Plat 12 (unfertilized),	Corn,	Kentucky blue-grass,	Kentucky blue-grass (fertilized August, 1889).
Plat 13 (fertilized),	Italian rye-grass (*Lolium Italicum*), English rye-grass (*Lolium perenne*),	Italian rye-grass, English rye-grass,	Red-cob ensilage corn.
Plat 14 (unfertilized),	Italian rye-grass, English rye-grass,	Italian rye-grass, English rye-grass,	Red-cob ensilage corn (fertilized May, 1889).
Plat 15 (fertilized),	Five varieties Southern cow-pea,	Soja bean (*Soja hispida*),	Bokhara clover (*Melilotus alba*). Sainfoin (*Onobrychis sativa*).
Plat 16 (unfertilized),	Five varieties Southern cow-pea,	Soja bean,	Bokhara clover (fertilized May, 1889). Sainfoin (fertilized May, 1889).
Plat 17 (fertilized),	Meadow fescue (*Festuca prætensis*),	Meadow fescue,	Meadow fescue.
Plat 18 (unfertilized),	Alsike clover (*Trifolium hybridum*), Medium red clover (*Trifolium pratense*),	Alsike clover, Medium red clover,	Red-cob ensilage corn (fertilized May, 1889).
Plat 19 (fertilized),	Alsike clover, Medium red clover,	Alsike clover, Medium red clover,	Alsike clover. Medium red clover.
Plat 20 (unfertilized),	Mammoth red clover (*Trifolium medium*), Alfalfa or lucerne (*Medicago sativa*),	Mammoth red clover, Alfalfa,	Red-cob ensilage corn (fertilized May, 1889).
Plat 21 (fertilized),	Mammoth red clover, Alfalfa,	Mammoth red clover, Alfalfa,	Corn (variety, Clark).

1889. — The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Kentucky blue-grass, Plat 11 (fertilized), was well preserved; the same circumstance was noticed on Plat 12 (unfertilized).

Perennial rye-grass, plats 13 and 14 (fertilized and unfertilized), was dead in the rows.

Italian rye-grass was fairly preserved in the rows on both plats.

Meadow fescue, Plat 17 (fertilized), was in a healthy and well-preserved condition.

Alsike clover, plats 18 and 19 (unfertilized and fertilized), had suffered somewhat on the unfertilized plat, but was well preserved upon the fertilized plat (19).

Medium red clover, raised on the same plats as the alsike, was in better condition upon the unfertilized plat (18) than the latter, yet fell behind on the fertilized plat (19).

Alfalfa, plats 20 and 21 (unfertilized and fertilized), was almost entirely winter-killed. The same feature was noticeable in regard to mammoth red clover, upon the unfertilized Plat 20, while upon Plat 21 (fertilized) a fair growth was noticed. The plats 15 and 16, which had been used in the preceding season for the production of Soja beans, were ploughed and prepared for seeding; the same course was pursued in regard to the grass and clover plats, where the growth had been seriously winter-killed, — plats 18, 20 and 21.

Plats 12, 14, 16, 18 and 20, which for five preceding years had not been fertilized, were treated, like all fertilized plats in this field, with eighty pounds of fine-ground bones and twenty-seven pounds of muriate of potash per acre.

Plats 15 and 16 were turned to account for the cultivation of Bokhara clover (*Melilotus alba*) and of sainfoin (*Onobrychis sativa*). Each plat was subdivided into two equal

parts, and seeded down, one-half with Bokhara clover and the other half with sainfoin, May 8.

Plats 13, 14, 18 and 20 were planted, May 27, with red-cob ensilage corn, a dent variety sent on for trial by Messrs. D. J. Bushnell & Co. of St. Louis. Nine quarts of corn were used for that purpose. Plat 21 was planted on the same day with two and one-half quarts of Clark corn, a flint variety of medium size.

The grasses and clover varieties were kept clean from weeds by the use of the cultivator and the hoe; a similar attention was bestowed upon the corn-bearing plats.

The Kentucky blue-grass, seeded down in 1888, proved to be largely a mixture of other grasses, herd's grass in particular. The grass on both plats was cut for hay June 24. Plat 11 (fertilized) yielded 520 pounds of hay, or 3,921 pounds per acre; Plat 12 (unfertilized) yielded 280 pounds of hay, or 2,111 pounds per acre. The sod was subsequently turned under, and both plats re-seeded with Kentucky blue-grass, September, 1889.

Meadow fescue, Plat 17, began to head out May 30; it bloomed June 4; it was thirty-six inches high when in full blossom. The cutting had to be deferred, on account of rainy weather, to June 20, when it measured forty-four inches in height. The first cut of hay weighed 560 pounds, or 4,422 pounds per acre; the second cut (rowen) of hay, September 4, weighed 290 pounds, or 2,187 pounds per acre. This grass compares well in quality and quantity with herd's grass; seeded down close, it forms a compact, healthy-looking sod.

Bokhara clover, Plat 15, was seeded May 8; it appeared above ground May 16; was eight inches high July 3, and thirty-two inches August 7; it was cut for hay September 9, and yielded at the rate of 3,090 pounds per acre. The second year's growth is usually much heavier; the plant dies out with the end of the second year. The large yield of vegetable matter, in particular during the second year, renders further observation with this plant for feeding purposes advisable.

Sainfoin, Plat 15, was seeded May 8; the young plants appeared above ground May 18; it measured four inches

July 3. The growth of the plant was very slow during the entire season. The land was cleaned from weeds September 24, and the crop left for another year's observation. Whether a cold and wet season caused this slow progress in the growth of this reputed fodder crop, has to be left for the future to decide.

Alsike clover, Plat 19, started up well in May; it was in full bloom June 3, and was cut for hay July 2. The clover hay weighed 155 pounds, or 2,400 pounds per acre.

Medium red clover, Plat 19, began blooming June 17; the crop was cut for hay July 12. The latter weighed 180 pounds, or 2,900 pounds per acre.

In the interest of a due appreciation of the annual yield stated in connection with the above-described grasses and clovers, attention is here once more called to the fact that all were raised in rows, and not broadcast. The rows were, in case of the grasses, for stated reasons, two feet apart, and in case of clovers three feet. The numerical statements regarding their annual yield are therefore mainly of interest as far as relative quantities are concerned. Taking this circumstance into due consideration, it will be conceded that the yield in some instances has been remarkably large; as, for instance, in the case of meadow fescue, — 4,422 pounds of hay in the first cut and 2,187 pounds in the second cut, or 6,609 pounds of hay per acre. On a previous occasion it has been already stated that the cultivation of grasses in drills has been adopted in our experiments, on account of the chances this system of cultivation offers to keep individual varieties of grasses free from foreign growth. The introduction of drill cultivation in connection with the raising of grain crops is deservedly urged upon the attention of farmers, in the interest of clean cultivation.

Red-cob ensilage corn, plats 13, 14, 18 and 20, was planted in drills with nine quarts of seed corn, May 25. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with from four to six seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances

advised. The young plants appeared above ground June 3. The crop looked vigorous and handsome throughout the entire season, yet was somewhat behind in its various stages of growth. The entire crop was cut for the silo September 6 and 7, although the ears were not yet as far advanced as desirable to secure the full benefit of the season. Early frosts oblige us to cut our corn crops at the beginning of the month of September. This feature of our local climate advises the selection of early-maturing varieties of corn. The green crop secured from the different plats varied widely in weight, — a result apparently largely due to the particular condition of the soil with reference to temporary available resources of plant food. The majority of plats (14, 18 and 20) had not been fertilized for several preceding years; Plat 13 was the only one, planted with the stated variety of corn, which for years had been fertilized with bone and potash. One year's treatment, spring of 1889, with a corresponding amount of these two manurial substances, did not raise their productiveness to its full capacity.

Plat	13	yielded	5,820	lbs.	green	fodder	corn, or	43,884	lbs. per acre.
"	14	"	4,755	"	"	"	"	35,853	" "
"	18	"	3,230	"	"	"	"	24,354	" "
"	20	"	2,560	"	"	"	"	19,302	" "

Clark corn, Plat 21, was planted on the same date as the former, and treated alike in all particulars; it did well throughout the season; it showed tassels July 19, and was cut for the silo September 7. The crop was more matured than the red-cob ensilage corn, yet was the lowest in weight, — 2,365 pounds per plat, or 17,832 pounds per acre. The main difference in the weight of the crops secured from both varieties of corn does not express their relative food value; yet the difference in that direction is so great that it must be admitted that the Clark corn is not a success as an ensilage corn.

Analyses of Crops raised upon Field B during the Summer Season of 1888.

Italian Rye Grass (1888).

	Collected June 29, 1888 in Bloom.		Collected July 16, 1888, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.30	8.96	8.22	7.38
Dry matter,	90.74	91.04	91.78	92.62
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	7.44	7.50	8.58	6.55
" cellulose,	31.27	32.79	36 90	32.38
" fat,	2.04	1.39	1.90	2.07
" protein (nitrogenous matter),	9.75	7.13	9.53	6.20
Non-nitrogenous extract matter,	49.50	51.19	43.09	52 80
	100.00	100.00	100.00	100.00

Fertilizing Constituents of Italian Rye Grass.

	Collected June 29, 1888. In Bloom.		Collected July 16, 1888, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.300	8.960	9.204	7.380
Calcium oxide,	.644	.639	.983	1.160
Magnesium oxide,	.357	.316	.328	.284
Ferric oxide,	.045	.042	.065	.130
Sodium oxide,	.151	.463	.795	.395
Potassium oxide (4¼ cts. per lb),	1.922	1.184	2.086	.940
Phosphoric acid (6 cts. per lb.),	.546	.572	.539	.564
Nitrogen (17 cts. per lb.),	1.415	1.039	1.381	.919
Insoluble matter,	1.922	2.602	2.290	3.507
Valuation per ton,	$7 10	$5 22	$6 24	$4 59

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Alsike Clover (1888).

	Collected June 21, 1888, in Bloom.		Collected July 18, 1888, in Seed.
	Fertilized.	Unfertilized.	Fertilized.
Moisture at 100° C.,	13.52	13 10	6.08
Dry matter,	86.48	86.90	93.92
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	15.91	9.90	8.26
" cellulose,	26 79	24.03	32.34
" fat,	2.19	1 88	3.07
" protein (nitrogenous matter),	16.48	17 55	14.77
Non-nitrogenous extract matter,	38.63	46.64	41.56
	100.00	100.00	100 00

Fertilizing Constituents of Alsike Clover.

	Collected June 21, 1888, in Bloom.		Collected July 18, 1888, in Seed.
	Fertilized.	Unfertilized.	Fertilized.
Moisture at 100° C.,	13 520	13 100	6 080
Calcium oxide,	2.119	2 608	2 838
Magnesium oxide,	.330	.705	.304
Ferric oxide,	.141	.202	.064
Sodium oxide,	.299	.273	.209
Potassium oxide,	4.308	1.087	2.602
Phosphoric acid,	.716	.704	.496
Nitrogen,	2.280	2.440	2.214
Insoluble matter,	.744	1.102	.420
Valuation per ton,	$12 27	$10 06	$10 34

Medium Red Clover (1888).

[Collected July 6, 1888, in bloom, fertilized.]

Moisture at 100° C.,	6.02
Dry matter,	93.98
	100.00

Analyses of Crops raised upon Field B — *Continued.*

Analysis of Dry Matter.

Crude ash,	8.90
" cellulose,	29.97
" fat,	2.62
" protein (nitrogenous matter),	14 63
Non-nitrogenous extract matter,	43 88
	100.00

Fertilizing Constituents of the Above Medium Red Clover.

Moisture at 100° C.,	6.020
Calcium oxide,	1.932
Magnesium oxide,	.423
Ferric oxide,	.064
Sodium oxide,	.201
Potassium oxide,	2.315
Phosphoric acid,	.459
Nitrogen,	2.198
Insoluble matter,	.267
Valuation per ton,	$9 99

Mammoth Red Clover (1888).

	Collected June 21, 1888, in Bloom.		Collected July 13, 1888, in Seed.
	Fertilized.	Unfertilized.	Unfertilized.
Moisture at 100° C.,	17.53	9.36	7.34
Dry matter,	82 47	90.64	92 66
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.50	10.50	8.53
" cellulose,	33.72	20.16	28.65
" fat,	2.25	1.86	2.25
" protein (nitrogenous matter),	14.69	18.50	14.06
Non-nitrogenous extract matter,	38.84	48.98	46 51
	100.00	100 00	100 00

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Fertilizing Constituents of Mammoth Red Clover.

	Collected June 21, 1888, in Bloom.		Collected July 23, 1888, in Seed.
	Fertilized.	Unfertilized.	Unfertilized.
Moisture at 100° C.,	17.530	9.360	7.340
Calcium oxide,	2.732	3.978	2.712
Magnesium oxide,	.312	.792	.735
Ferric oxide,	.057	.144	.133
Sodium oxide,	.512	.558	.098
Potassium oxide,	2 430	.726	.513
Phosphoric acid,	.504	.704	.421
Nitrogen,	1.938	2.680	2.075
Insoluble matter,	.261	.908	1.168
Valuation per ton,	$9 26	$10 57	$8 00

Alfalfa (1888).

	Collected June 29, 1888, in Bloom.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	4.68	4.60
Dry matter,	95.32	95.40
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.97	7.10
" cellulose,	34.39	32 41
" fat,	1.12	1.04
" protein (nitrogenous matter),	16.27	14.41
Non-nitrogenous extract matter,	40.25	45.04
	100.00	100.00

ANALYSES OF CROPS RAISED UPON FIELD B — *Concluded.*

Fertilizing Constituents of Alfalfa.

	Collected June 29, 1888, in Bloom. Fertilized.	Collected June 29, 1888, in Bloom. Unfertilized.
Moisture at 100° C.,	4.680	4.600
Calcium oxide,	1.944	2.855
Magnesium oxide,	.279	.513
Ferric oxide,	.050	.070
Sodium oxide,	.079	1.156
Potassium oxide,	2.038	.891
Phosphoric acid,	.556	.645
Nitrogen,	2.481	2.200
Insoluble matter,	.140	.508
Valuation per ton,	$10 84	$9 00

Soja Bean (Entire Plant, Dry).

[Collected Aug. 30, 1888, unfertilized.]

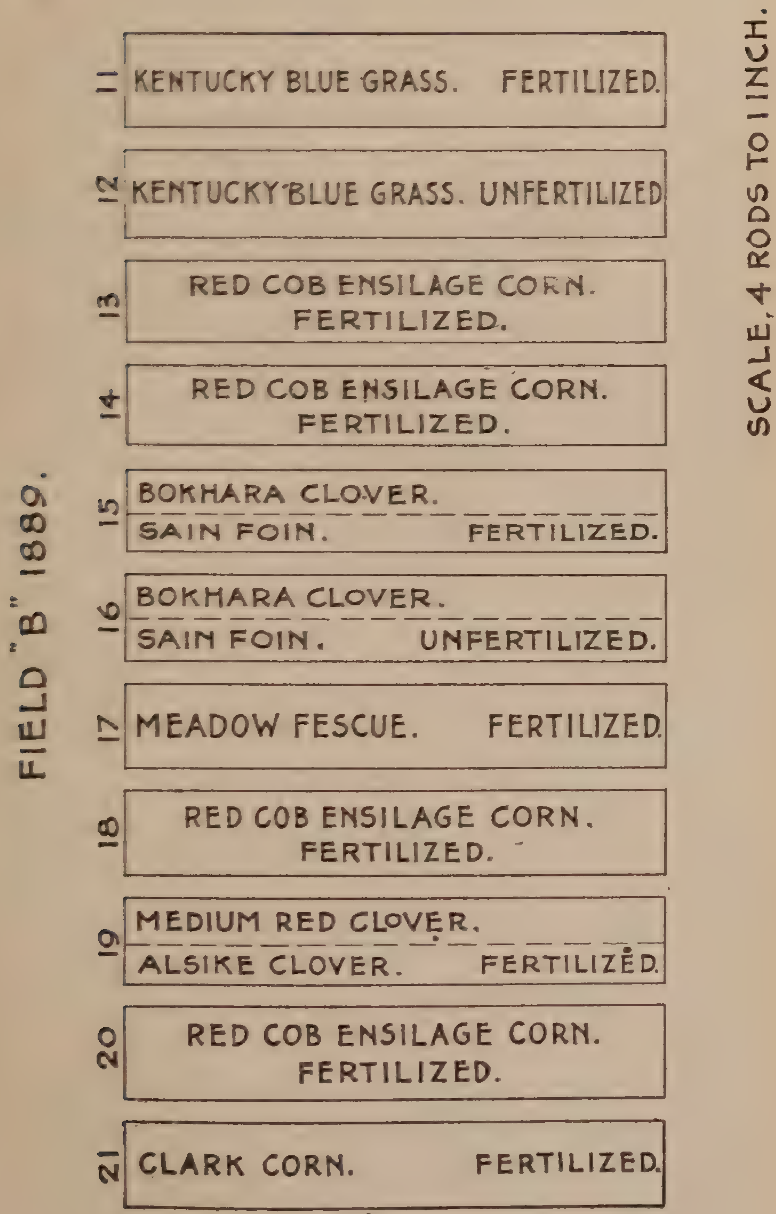
Moisture at 100° C.,	6.12
Dry matter,	93.88
	100.00

Analysis of Dry Matter.

Crude ash,	6.47
" cellulose,	20.76
" fat,	5.62
" protein (nitrogenous matter),	15.87
Non-nitrogenous extract matter,	51.28
	100.00

Fertilizing Constituents of the Above Soja Bean.

Moisture at 100° C,	6.120
Calcium oxide,	2.770
Magnesium oxide,	1.190
Ferric oxide,	.131
Sodium oxide,	.198
Potassium oxide,	.617
Phosphoric acid,	.753
Nitrogen,	2.380
Insoluble matter,	.967
Valuation per ton,	$9 51


FIELD "B" 1889.
SCALE, 4 RODS TO 1 INCH.
11 KENTUCKY BLUE GRASS. FERTILIZED.
12 KENTUCKY BLUE GRASS. UNFERTILIZED
13 RED COB ENSILAGE CORN. FERTILIZED.
14 RED COB ENSILAGE CORN. FERTILIZED.
15 BOKHARA CLOVER. SAIN FOIN. FERTILIZED.
16 BOKHARA CLOVER. SAIN FOIN. UNFERTILIZED.
17 MEADOW FESCUE. FERTILIZED.
18 RED COB ENSILAGE CORN. FERTILIZED.
19 MEDIUM RED CLOVER. ALSIKE CLOVER. FERTILIZED.
20 RED COB ENSILAGE CORN. FERTILIZED.
21 CLARK CORN. FERTILIZED.

III. Experiments with Field and Garden Crops. (Fields C and D, 1889.)

A short description of the work carried on upon these fields during the preceding year, 1888, may serve as an introduction to a brief statement of the course adopted in 1889.

Field C, 1888.— This field comprises an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26 ; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west; they are separated from each other by a passageway three feet wide. The northern half of the field is 70 feet wide and 328 feet long ; the southern half is the same length, but 109 feet wide.

The latter was again subdivided into three equal parts, each 111 by 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and oats (variety Western). The middle division was planted the same day with serradella and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart.

The northern half of Field C was occupied by a series of crops in rows, running north and south, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning at the east end : —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.

Teosinte (*Euchlœna luxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture. (For details, see sixth annual report, pages 115 to 120.)

Field C, 1889. — The entire area of both divisions of this field was carefully prepared in a similar manner as in the preceding spring. It was ploughed and harrowed April 20, and fertilized broadcast with fine-ground bone and muriate of potash, at the rate of six hundred pounds of the former and two hundred pounds of the latter. The entire southern half of the field was planted with roots, while the northern half was used for raising a variety of fodder and garden crops. The majority of the seeds used in this connection were sent on by the United States Department of Agriculture; others came from parties more or less directly interested in the particular variety sent on for trial; some were bought of reliable parties. Most of these seeds were planted merely for the purpose of studying their particular degree of adaptation to our climate and soil, to secure suitable material for analysis, and to ascertain their relative proportion of essential nutritive constituents. As this part of our work requires exceptional accommodation for analytical work, it has to be largely deferred to a more favorable part of the year. This circumstance must serve as our excuse for publishing some analyses of the crops raised in 1888 for the first time on the present occasion.

Description of the Principal Crops raised on the Southern Division of Field C, beginning at the West End.

American ruta-baga turnips of Delano Moore, Presque Isle, Me., two rows, 109 feet long and 2 feet apart, were planted May 3. The young plants appeared above ground May 11; they were thinned out in the rows to eight inches

of space between them, July 1, and subsequently kept clean from weeds by a periodical use of the cultivator and the hoe. A blight which appeared during the first week of August on the leaves did considerable injury to the earlier foliage; the later leaves suffered less seriously. The crop was harvested October 22; the roots weighed 170 pounds. Photographs representing fair specimens of the roots will be found farther on. An analysis stating the composition of a medium-sized root is reported at the close of this chapter.

Lane's Sugar Beet. — The seeds used in this case were sent on by C. H. Lane of Middlebury, Vt. The area occupied by the plant measured 1,090 square feet. The seeds were planted in rows two feet apart, May 3; the young plants appeared above ground May 11; they were thinned out in the rows to six inches space between them, June 18, and kept clean from weeds by cultivator and hoe in the same manner as the previously described crop. The first growth of leaves suffered seriously from a blight, the later leaves were entirely free from blight, and made a vigorous growth. The crop was harvested October 19; it weighed 610 pounds, without the leaves. A photograph of different sizes of the roots, and an analysis stating the composition of a medium-sized root, will be found farther on.

Saxony Sugar Beet. — This crop occupied an area of 15,587 square feet. The seed was sown in rows two feet apart, to admit the use of a one-horse cultivator, May 3. The seeding was heavy; five and one-half ounces of seed were used. The young plants were thinned out and treated like the previously stated crop. The unfavorable, cold, wet weather during the fore part of the summer season affected this crop in a similar way as the preceding root crops. Insects and a blight destroyed almost entirely the first leaf growth. The later leaves were vigorous, and apparently free from blight. The roots were harvested October 19; they weighed 6,450 pounds, or nine tons per acre, which is about one-half an average crop. Photographs and a chemical analysis accompany these statements.

Carrots, Danvers. — The land occupied by this crop measured 18,420 square feet; the seed was sown in rows, leaving fourteen inches of space between, May 13; fourteen

ounces of seed were used for that purpose. The plants came up May 21; they were thinned out by hand in the rows from two to three inches apart. The crop was kept clean by weeding with the hand and the hoe. The leaves suffered somewhat from blight during the earlier part of the month of August. The roots were harvested October 17; they weighed 11,390 pounds, or $13\frac{1}{3}$ tons per acre.

The serious influence of an unfavorable season on the yield of the root crops has been a marked one. The roots were much smaller than in preceding years; this circumstance applies with particular force to the different varieties of sugar beets on trial. The crops have fallen behind in these cases more than fifty per cent. of a fair average yield. The yield of carrots is one-third less than that obtained in preceding years.

Statement of Crops raised on the Northern Division of Field C.

This section of Field C is 70 feet wide and 328 feet long, and laid out in rows from two to three feet apart, as circumstances may advise. Most of the crops raised here are merely on trial, to study their general adaptation to our soil and climate; a few rows represent in most instances the extent of the area occupied by each of them. In many instances merely a sufficient amount is raised to secure suitable samples for chemical examination. Wherever the results in the field and in the laboratory are encouraging, as far as fodder crops new to our section of the country are concerned, larger fields will be devoted subsequently, to test their respective agricultural merits on a becoming scale.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crops (aside from the products of pastures and meadows), — the fodder corn and corn stover.

A more detailed discussion of this important question may be found in our fifth annual report, page 88, and sixth annual report, page 115.

The crops were arranged in the following order, beginning at the west end : —

Erfurt earliest cauliflower, two rows.
Early snowball cauliflower, two rows.
Haines No. 64 tomato, two rows.
Honduras sorghum, seven rows.
New orange sorghum, seven rows.
Kansas orange sorghum, seven rows.
Price's new hybrid sorghum, seven rows.
Early Tennessee sorghum, seven rows.
Bokhara clover (*Melilotus alba*), three rows.
Bokhara clover (*Melilotus cæruleus*), three rows.
Lotus villosus, two rows.
Pyrethrum roseum, one row.
Sulla (*Hedysarum coronaria*), one row.
Pease, one row.
Dwarf Lima beans, one-half row.
Early cow-pea, one and one-half rows.
Black soja bean, five rows.
Blue lupine, two rows.
Cow-pea, three rows.
Horse bean, three rows.
Japan clover (*Lespideza striata*), five rows.
Chapman honey plant, three rows.
New Japanese buckwheat, seventeen rows.
Common barley, fifteen rows.
Hulless black barley, fifteen rows.

American Ruta Baga Turnips.

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Saxony Sugar Beets.

Lane's Sugar Beets.

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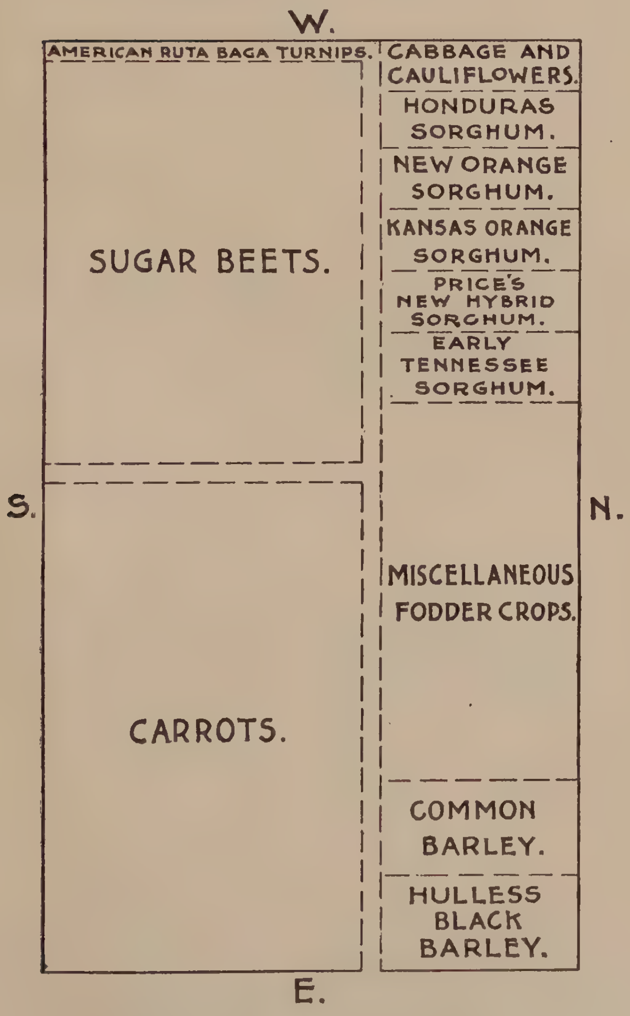
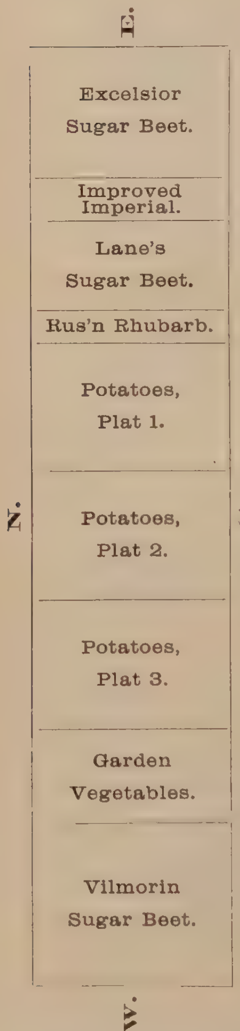
FIELD "C" 1889.



SCALE, 4 RODS TO 1 INCH.

Field D, 1888. — This field is 328 feet long and 70 feet wide, covering an area of 22,960 square feet. It has been used during previous years for the raising of a variety of garden and field crops, on a larger or smaller scale. The soil has been usually ploughed late in the fall and early in the succeeding spring. The manure has been applied in every instance early in the spring, after ploughing, and subsequently slightly harrowed under. With the exception of the potato plats used for studying the causes of the scab on potatoes, but one fertilizer, consisting of fine-ground bones with muriate of potash, six hundred pounds of the former and two hundred pounds of the latter per acre, has been used upon this field. The distribution of the crops raised during the year 1888 may be seen from the accompanying sketch. Some analyses of crops raised during that year are for stated reasons published farther on for the first time, in connection with analyses made of crops raised during the present year.

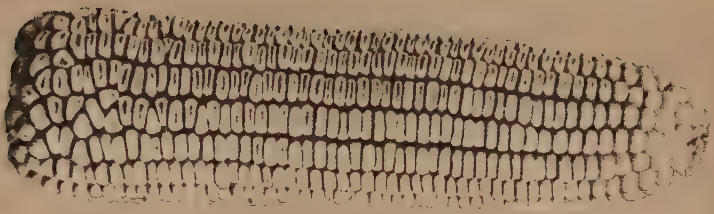
FIELD D, 1888.*



* Scale, 4 rods to 1 inch.

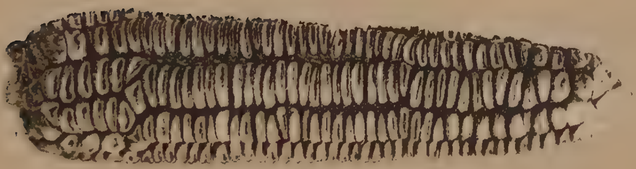
1889. — The preparation of the soil, as well as the system of manuring, was in all its details the same as in the preceding years. The crops were planted in rows, and kept clean by the timely use of the cultivator and the hoe. They were arranged in the following order, beginning at the west end of the field: —

Red-cob Ensilage Corn. — The seed was sent on, with a request for a trial, by D. I. Bushnell & Co., St. Louis, Mo. An area of 5,460 square feet was assigned in this field for our observation. The seed was planted May 7; the young plants appeared above ground in



1. Red Cob Ensilage Corn.

2. Pride of the North Corn.



3. Minnesota King Corn.

4. Clark Corn.

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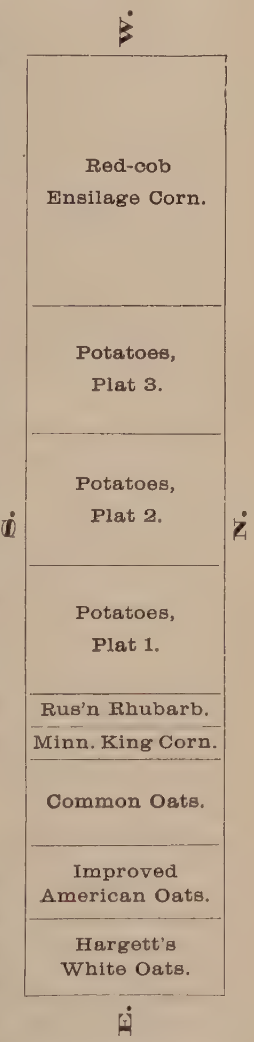
May; tassels were first noticed July 30. The growth measured at this time 70 inches in height; it was 105 inches high at the appearance of silk. The field looked extremely vigorous and handsome at this stage of the growth, — middle of August. The leaves died, however, soon, largely beginning at the lower end of the stalks. Most of the foliage up to the middle of the stalks was dead before the kernels began to glaze over. The plants measured 10½ feet in height when cut, October 2. The ears were at this late date not yet fully matured; they were also to a considerable degree imperfect in their general development. We obtained 475 pounds of ears and 2,550 pounds of stover.

The exceptionally cool and wet weather during the months of July and August has no doubt largely contributed to the unsatisfactory termination of our trial for a matured crop. Late maturing varieties of corn offer but little chance with us for a successful curing. Our trial for ensilage has been referred to in some preceding pages (Field B). The general character of a well-matured ear of this handsome corn may be judged from a description and photograph of an ear sent on to the station, which occur farther on.

Potatoes (Beauty of Hebron). — Three plats for several years assigned to this crop to study the causes of scab were prepared and manured in exactly the same manner as in previous years. They were planted with healthy tubers, May 1; the young crop showed itself pretty uniformly over the entire field, May 16. A blight appeared at the close of the month of July; it spread so rapidly that it killed within a week the

FIELD D, 1889.*



* Scale, 4 rods to 1 inch.

entire vines. The crop was harvested without delay, yet proved a total failure; the tubers, almost without an exception, were full of scab and soon rotted.

The experiments regarding the cause of scab on potatoes, which for several years past have been carried on upon this part of our field, have been transferred to Field E; they have been placed, since the beginning of 1889, under the special direction of Prof. J. E. Humphrey. His elaborated report regarding his studies of scab and other plant diseases, which forms a part of this report, cannot fail to engage the attention of all parties interested in the subject discussed.

Minnesota King Corn. — Two samples were sent on by Northrup, Braslan & Goodwin of Minneapolis, Minn. Two rows were planted May 14; the plants reached a height of 66 inches and matured during the first week of September. They compared well with other medium-sized varieties current in our vicinity; no special merits were noticed. The general character of the corn may be judged from a short description and photograph which may be found farther on.

Oats. — Three varieties were planted. The seeds of two varieties — "Hargett's White" (Seizure) and "Improved American" — were sent by the United States Department of Agriculture; the third variety, commonly called "Connecticut Valley Oats," was secured from a farmer in our vicinity. The latter, one of the most prominent home varieties of oats, was included in our observation for the purpose of comparing the individual merits, if any, of the different varieties on trial, as far as practicable under corresponding circumstances. The seeds were planted, each fifteen rows, two feet apart. The main difference in the advancing growth consisted in a deep-green color of the Improved American. The latter exceeded the other varieties by three inches in height at the close of the season. All matured about the same time, and were cut on the same day, July 19. When harvested, July 23, the entire crop of the Hargett's White weighed 360 pounds; of the home variety, weighed 350 pounds; of the Improved American, weighed 390 pounds.

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Russian Rhubarb Roots.

Most of our grain crops suffered more or less from smut. The season was evidently not favorable for comparative trial of grain crops.

Russian Rhubarb. — Some years ago a small sample of seeds of this plant was sent on to the station by the Secretary of the American Retail Druggist Association, with the request to experiment with them upon our fields. The seed was represented as genuine by an officer of the Russian government, who procured it for the association. Several plants raised from this seed have been for a number of years cultivated very successfully on our ground. Well-matured seed has been collected every year, and some of it was sown two years ago. Quite a number of roots have been collected for trial by druggists. Parties interested in the question of their fitness for medicinal purposes can secure a specimen for trial, if early applied for. An attempt has been made to give a correct picture of the roots in different positions by the photographs accompanying this chapter. Photographs of the same kind of crop have in every instance been taken at equal distance from the camera, that their relative sizes might be observed.

Description of the Ears of Corn illustrated by the Following Photographs.

1. Red-cob ensilage corn, a dent variety mentioned in this chapter.
2. Pride of the North corn, a dent variety largely grown upon the station grounds.
3. Minnesota king corn, a dent corn mentioned in this chapter.
4. Clark corn, a flint corn which has served for our observations on Field A.

	Number of Rows.	Number of Kernels per Row.	Length of Ear (Inches).	Weight of Ear (Grams).*	Weight of Kernels (Grams).	Weight of Cob (Grams).	Ratio of Cob to Kernels.	Average weight of Kernels (Grams).
1, . . .	16	54	8½	396	339	57	1 : 5.95	.97
2, . . .	16	46	8	205	178	27	1 : 6.59	.25
3, . . .	8	44	7½	157	110	47	1 : 2.34	.31
4, . . .	8	48	8½	159	128	31	1 : 4.13	.336

* One ounce equals about thirty grams.

Teosinte (Euchlæna luxurians).

[Collected Sept. 7, 1888, in full bloom.]

	Per Cent.
Moisture at 100° C.,	6.06
Dry matter,	93.94
	100.00

Analysis of Dry Matter.

Crude ash,	6.95
" cellulose,	28.88
" fat,	1.28
" protein (nitrogenous matter).	9.71
Non-nitrogenous extract matter,	53.18
	100.00

In green material, moisture 89.42 per cent.; dry matter, 10.58 per cent.

Fertilizing Constituents of Teosinte.

Moisture at 100° C.,	6.060
Calcium oxide,	1.597
Magnesium oxide,	.458
Ferric oxide,	.021
Sodium oxide,	.109
Potassium oxide (4½ cents per pound),	3.696
Phosphoric acid (6 cents per pound),	.546
Nitrogen (17 cents per pound),	1.460
Insoluble matter,	.315
Valuation per ton,	$8 76

Lotus villosus (Second Year's Growth).

[Collected June 21, 1889, in full bloom.]

	Per Cent.
Moisture at 100° C.,	10.68
Dry matter,	89.32
	100.00

Analysis of Dry Matter.

Crude ash,	8.23
" cellulose,	24.48
" fat,	3.00
" protein (nitrogenous matter),	13.49
Non-nitrogenous extract matter,	50.80
	100.00

In green material, moisture 83.37 per cent.; dry matter, 16.63 per cent.

Lotus villosus (First Year's Growth).

[Collected Sept. 7, 1888, blooming.]

	Per Cent.
Moisture at 100° C.,	12.36
Dry matter,	87.64
	100.00

Analysis of Dry Matter.

Crude ash,	8.30
" cellulose,	15.07
" fat,	2.69
" protein (nitrogenous matter),	16.12
Non-nitrogenous extract matter,	57.82
	100.00

In green material, moisture 88.63 per cent.; dry matter, 11.37 per cent.

Fertilizing Constituents of Lotus villosus.

Moisture at 100° C.,	12.360
Calcium oxide,	2.861
Magnesium oxide,	.615
Ferric oxide,	.148
Sodium oxide,	.633
Potassium oxide (4¼ cents per pound),	1.550
Phosphoric acid (6 cents per pound),	.500
Nitrogen (17 cents per pound),	2.259
Insoluble matter,	1.053
Valuation per ton,	$9 60

Sulla (Hedysarum coronaria).

[Collected Oct. 3, 1888, at the close of the period of blooming.]

	Per Cent.
Moisture at 100° C.,	10.46
Dry matter,	89.54
	100.00

Analysis of Dry Matter.

Crude ash,	8.77
" cellulose,	12.38
" fat,	3.16
" protein (nitrogenous matter),	17.03
Non-nitrogenous extract matter,	58.66
	100.00

In green material, moisture 74.21 per cent.; dry matter, 25.79 per cent.

Fertilizing Constituents of Sulla.

	Per Cent.
Moisture at 100° C.,	10.460
Calcium oxide,	2.791
Magnesium oxide,	.378
Ferric oxide,	.147
Sodium oxide,	.362
Potassium oxide (4¼ cents per pound),	1.872
Phosphoric acid (6 cents per pound),	.424
Nitrogen (17 cents per pound),	2.441
Insoluble matter,	.987
Valuation per ton,	$10 40

Hairy Vetch (Vicia villosa).

[Collected Sept. 3, 1888, blooming.]

	Per Cent.
Moisture at 100° C.,	7.44
Dry matter,	92 56
	100.00

Analysis of Dry Matter.

Crude ash,	8.37
" cellulose,	31.88
" fat,	1.22
" protein (nitrogenous matter),	19.58
Non-nitrogenous extract matter,	38.95
	100 00

In green material, moisture 78.01 per cent ; dry matter, 21 99 per cent.

Bokhara or Sweet Clover (Melilotus alba).

[Collected Oct. 3, 1888, at the close of the period of blooming.]

	Per Cent.
Moisture at 100° C.,	6.36
Dry matter,	93.64
	100.00

Analysis of Dry Matter.

Crude ash,	6.90
" cellulose,	28.08
" fat,	1.85
" protein (nitrogenous matter),	11.81
Non-nitrogenous extract matter,	51.36
	100.00

In green material, moisture 76.52 per cent.; dry matter, 23.48 per cent.

Fertilizing Constituents of Bokhara Clover.

	Per Cent.
Moisture at 100° C.,	6.360
Calcium oxide,	1.938
Magnesium oxide,	.373
Ferric oxide,	.028
Sodium oxide,	.077
Potassium oxide (4¼ cents per pound),	1.673
Phosphoric acid (6 cents per pound),	.436
Nitrogen (17 cents per pound),	1,770
Insoluble matter,	.013
Valuation per ton,	$7 96

Melilotus cœruleus.

[Collected Aug. 6, 1889, somewhat past blooming.]

	Per Cent.
Moisture at 100° C.,	8.22
Dry matter,	91.78
	100.00

Analysis of Dry Matter.

Crude ash,	14.87
" cellulose,	27.17
" fat,	1.67
" protein (nitrogenous matter),	13.07
Non-nitrogenous extract matter,	43.22
	100 00

Fertilizing Constituents of Melilotus cœruleus.

Moisture at 100° C.,	8.220
Calcium oxide,	1.449
Magnesium oxide,	.260
Ferric oxide,	.349
Sodium oxide,	.270
Potassium oxide (4¼ cents per pound),	2.796
Phosphoric acid (6 cents per pound),	.544
Nitrogen (17 cents per pound),	1.919
Insoluble matter,	4.008
Valuation per ton,	$9 55

Danvers Carrots.

[Grown on Field C, 1888.]

	Per Cent.
Moisture at 100° C.,	90.05
Dry matter,	9.95
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	8.28
" cellulose,	10.20
" fat,	1.67
" protein (nitrogenous matter),	7.98
Non-nitrogenous extract matter,	71.81
	100.00

Nutritive ratio, 1 : 9.17.

Carrot Tops (Danvers).

[Collected Oct. 31, 1889, two weeks after harvesting.]

	Per Cent.
Moisture at 100° C.,	9.76
Dry matter,	90 24
	100.00

Analysis of Dry Matter.

Crude ash,	13.87
" cellulose,	13.61
" fat,	2.01
" protein (nitrogenous matter),	20.12
Non-nitrogenous extract matter,	50.39
	100.00

In green material, moisture, 76.79 per cent.; dry matter, 23.21 per cent.

Sugar Tests of Sorghum (1889).

[Per Cent.]

	Moisture at 100° C.	Glucose.	Sucrose.	Total Sugar.
Early Tennessee (over-ripe),	77.43	1.79	3.21	5.00
Price's New Hybrid (ripe),	77.80	2.92	3.78	6.70
Kansas Orange (green),	80.67	2.38	3.63	6.01
New Orange (green),	78.30	2.96	3.85	6.81
Honduras (green),	77.55	3.08	4.01	7.09

Beets, Field D (1888).

[I. Excelsior Sugar Beet; II. Improved Imperial; (?) III. Vilmorin Sugar Beet.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	86.95	90.60	86.73
Dry matter,	13.05	9.40	13.27
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	3.21	10.09	5.70
" cellulose,	5.83	7.83	4.82
" fat,	.72	1.80	.73
" protein (nitrogenous matter),	8.74	12.78	8.45
Non-nitrogenous extract matter,	81.50	67.50	80.30
	100.00	100.00	100.00
Sugar,	9.84	3.45	7.24

Fertilizing Constituents of the Above Beets.

	PER CENT.	
	II.	III.
Moisture at 100° C.,	90.600	86.730
Calcium oxide,	.045	.056
Magnesium oxide,	.030	.037
Ferric oxide,	.005	.009
Sodium oxide,	.104	.170
Potassium oxide,	.462	.170
Phosphoric acid,	.086	.028
Nitrogen,	.192	.181
Insoluble matter,	.015	.090
Valuation per ton,	$1 14	$0 79

Beets, Field D (1888).

[IV. Lane's Sugar Beet; V. New Market Gardener Beet; VI. Eclipse Beet; VII. Osborn's Selected Beet.]

	Per Cent.			
	IV.	V.	VI.	VII
Moisture at 100° C.,	84.56	89.65	90 25	88.80
Dry matter,	15.44	10.33	9.75	11.20
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	6.87	7.21	9.77	7.87
" cellulose,	6.17	7.56	7.22	6.71
" fat,	.66	.59	.74	.64
" protein (nitrogenous matter),	10.63	14.29	15.40	14.46
Non-nitrogenous extract matter,	75.67	70.35	66.87	70 32
	100.00	100.00	100.00	100.00

Fertilizing Constituents of the Above Beets.

	Per Cent.		
	V.	VI.	VII.
Moisture at 100° C.,	89.650	90.250	88.800
Calcium oxide,	.032	.044	.064
Magnesium oxide,	.022	.032	.028
Ferric oxide,	.003	.005	.002
Sodium oxide,	.060	.110	.156
Potassium oxide,	.481	.467	.313
Phosphoric acid,	.085	.091	.069
Nitrogen,	.236	.240	.259
Insoluble matter,	.009	.016	.010
Valuation per ton,	$1 41	$1 33	$1 23

Determination of Albuminoid Nitrogen (1888).

	PER CENT. IN DRY MATTER.		
	Albuminoid Nitrogen.	Non-albuminoid Nitrogen.	Total Nitrogen.
Root, No. 1,	.58	.82	1.40
" 2,	.85	1.19	2.04
" 3,	.50	.85	1.35
" 4,	.67	1.03	1.70
" 5,	.76	1.53	2 29
" 6,	.84	1.63	2.47
" 7,	.78	1.53	2.31

Potatoes (1887).

[I. Polaris, healthy tubers; II. Beauty of Hebron, healthy tubers; III. Beauty of Hebron, healthy tubers; IV. Beauty of Hebron, scabby tubers.]

	PER CENT.			
	I.	II.	III.	IV.
Original moisture,	80.20	80.73	81.53	82.15
Original dry matter,	19.80	19.27	18.47	17.85
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	5.17	5.17	6.27	6.35
" cellulose,	1.91	3.32	3.22	3.55
" fat,	0.62	0.57	0.52	0.58
" protein (nitrogenous matter),	10.74	9.58	9.73	10.70
Non-nitrogenous extract matter,	81.56	81.36	80.26	78.80
	100.00	100.00	100.00	100.00
Albuminoid nitrogen, in dry matter,	.91	.73	.77	.92
Non-albuminoid nitrogen, in dry matter,	.80	.80	.79	.79
Total nitrogen, in dry matter,	1.71	1.53	1.56	1.71

Tabular Statement, showing the Loss in Weight, by Evaporation of Moisture, of Two Potatoes (Beauty of Hebron) kept in a Dry Cellar.

[Weight of potatoes Sept. 13, 1887: No. 1, 108.1210 grams; No. 2, 90.5225 grams.]

DATE OF WEIGHING.	PER CENT. OF ORIGINAL WEIGHT LOST SINCE PRECEDING WEIGHING.		PER CENT. OF ORIGINAL WEIGHT LOST SINCE SEPT. 13, 1887.	
	Potato No. 1.	Potato No. 2.	Potato No. 1.	Potato No. 2.
1887.				
September 26, . . .	1.43	1.43	1.43	1.43
October 10, . . .	.74	.72	2.17	2.15
October 24, . . .	.67	.66	2.84	2.81
November 7, . . .	.55	.53	3.39	3.32
November 21, . . .	.50	.48	3.89	3.80
December 5, . . .	.52	.51	4.41	4.31
December 19, . . .	.55	.52	4.96	4.83
1888.				
January 2, . . .	.55	.53	5.51	5.36
January 16, . . .	.66	.68	6.17	6.04
January 30, . . .	.66	.70	6.83	6.74
February 13, . . .	.89	.93	7.72	7.67
February 27, . . .	1.47	1.41	9.19	9.08
March 12, . . .	1.71	1.78	10.90	10.86
March 28, . . .	2.23	2.20	13 13	13.06
April 9, . . .	2.01	1.88	15.14	14.94

Both potatoes began to sprout Jan. 7, 1888.

American Ruta-baga Turnips (1889).

	Per Cent.
Moisture at 100° C.,	91.75
Dry matter,	8.25
	100.00

Analysis of Dry Matter.

Crude ash,	11.89
" cellulose,	13.12
" fat,	1.26
" protein (nitrogenous matter),	11.46
Non-nitrogenous extract matter,	62.27
	100.00

Fertilizing Constituents of American Ruta-baga Turnips.

Moisture at 100° C.,	91.750
Calcium oxide,	.083
Magnesium oxide,	.030
Ferric oxide,	.005
Sodium oxide,	.009
Potassium oxide,	.468
Phosphoric acid,	.106
Nitrogen,	.151
Insoluble matter,	.015
Valuation per ton,	$1 04

Lane's Sugar Beet (Field C, 1889).

	Per Cent.
Moisture at 100° C.,	90.13
Dry matter,	9.87
	100.00

Analysis of Dry Matter.

Crude ash,	14.54
" cellulose,	9.69
" fat,	.83
" protein (nitrogenous matter),	13.01
Non-nitrogenous extract matter,	61.93
	100.00

Fertilizing Constituents of Lane's Sugar Beet.

Moisture at 100° C.,	90.130
Calcium oxide,	.062
Magnesium oxide,	.043
Ferric oxide,	.007
Sodium oxide,	.006
Potassium oxide,	.720
Phosphoric acid,	.134
Nitrogen,	.205
Insoluble matter,	.038
Valuation per ton,	$1 47

Saxony Sugar Beet (Field C, 1889).

	Per Cent.
Moisture at 100° C.,	88.38
Dry matter,	11.62
	100.00

Analysis of Dry Matter.

Crude ash,	9.14
" cellulose,	6.70
" fat,	.59
" protein (nitrogenous matter),	10.06
Non-nitrogenous extract matter,	73 51
	100.00

Fertilizing Constituents of Saxony Sugar Beet.

Moisture at 100° C.,	88.380
Calcium oxide,	.052
Magnesium oxide,	.044
Ferric oxide,	.009
Sodium oxide,	.004
Potassium oxide,	.617
Phosphoric acid,	.103
Nitrogen,	.187
Insoluble matter,	.022
Valuation per ton,	$1 28

IV. Experiments with Green Crops for Summer Feed of Milch Cows. (Field F.)

The field selected for the raising of green fodder crops for experiments with milch cows (see second feeding experiment, page 48 of this report), had been used for a series of years as a meadow for the production of hay. During the fall of 1887, a piece of land, 300 feet long and 137 feet wide, was ploughed, and the succeeding spring, 1888, after a proper mechanical condition was secured, seeded down with Hungarian grass. After this crop was removed into a silo, the soil was turned, and left in that state for the following year.

1889. — In working out our plans for future experiments upon this field, it was decided to turn the still existing resources of available plant food to account for the raising of Southern cow-peas, serradella, and a mixture of vetch and oats. This decision was made for the following reasons: these crops had given much satisfaction in preceding years, when fed as green fodder to milch cows; they promised, judging from our own experience in adjoining fields, a fair yield when following grass and corn without any use of manure; and they would each reach in a desired succession a stage of growth best adapted for their profitable use as green fodder. The field was ploughed and harrowed early in the season (April, 1889), and subsequently subdivided into three equal parts, 300 feet long and 43 feet wide, with four feet unoccupied space between the plats (see sketch, Field F).

The plat along the north side of the field, 12,900 square feet, was seeded broadcast with twenty-five pounds each of vetch and oats, April 26.

The middle subdivision was sown in drills three feet apart, with eleven pounds of serradella seed. May 8.

The plat along the south side of the field was sown in drills three feet apart, with twenty-five pounds of Southern cow-peas (Clay variety), April 8.

Vetch and Oats. — The oats appeared first above ground; the vetch followed, May 6. The crop was eleven inches

high, June 11; it measured twenty-five inches, June 19. The oats began to head out, June 24, and the vetch to bloom, June 25; the entire growth was, on an average, thirty inches high, June 28, when the cutting for the daily feed began. The last of the crop was cut July 17; it had reached a height of forty inches. The average moisture of the green fodder for the entire period was 78.26 per cent., which makes the solid vegetable matter 21.74 per cent. The entire yield of the green crop was 5,440 pounds, or $8\frac{1}{2}$ tons per acre. This result is not as good, as far as quantity is concerned, as that secured during the preceding year, when a mixture of 25 pounds of vetch and 50 pounds of oats were used as seed; the rate of yield per acre in that year was $9\frac{1}{2}$ tons of green fodder. The area occupied by vetch and oats was not large enough to answer fully our purpose, to cover the time until the cow-pea is fit to be used advantageously. We shall hereafter double the area, and seed one-half down, as we did before, towards the close of April, and the other half from two to three weeks later.

Serradella. — The young plants were out May 16. The crop was kept clean with the cultivator and hoe. It is a peculiar feature of this crop, that its growth is very slow until it begins to bloom, when it rapidly branches out, and causes finally a compact, bulky green mass, filling out completely the three feet of space between the rows. The seed was sown, May 8; the plants appeared above ground, May 16; they were but one inch high, June 11; two inches, June 19; two and one-half inches, June 26; and four inches, July 3; began blooming, July 6; ten inches high, July 24; began spreading, July 31; reached thirteen inches in height, August 21. The first feed was cut September 11, when it formed a dense mass, several feet wide; the last feed was cut September 27. The green crop harvested amounted to 8,350 pounds, or $13\frac{1}{2}$ tons per acre. The average moisture was 83.65 per cent., and the solid vegetable matter 16.35 per cent.

Southern Cow-pea. — The young plants were seen six days after planting. The crop was cultivated and kept

clean in common with the preceding one; its leaves were slightly injured by frost, May 29. The growth was three inches high, June 11; five and one-half inches, June 26; eight inches, July 3; seventeen inches, July 17; twenty-four inches, August 21, when blossoms appeared. The first cut for fodder was made September 1, and the last, September 10. The entire yield of green fodder amounted to 6,125 pounds, or 10 tons per acre. The average moisture of the crop when fed was 83.07 per cent., leaving, for the solid vegetable matter, 16.93 per cent. The frequent rains during the late summer and the autumn have apparently favored an increase in the yield of green fodder. Whether their composition has suffered, will be learned from a comparison of our analyses of past years.

The general characteristics of the crops above mentioned have been stated in previous reports, and their good services in the dairy are confirmed by our own observations. We can only repeat in this connection the views advanced in previous reports.

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business; for it secures a liberal supply of healthy, nutritious fodder, at the same time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen-containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

Our prominent fodder crops may be classified, in regard to the relative proportion of their nitrogenous organic food

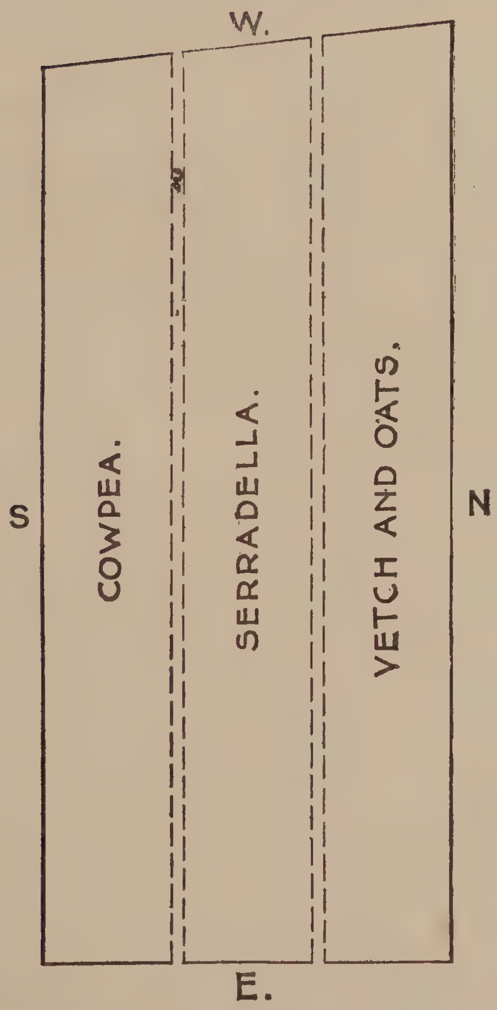
constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order: —

1.	Leguminous plants, clovers, vetches, etc.,	1:2.2 to 1: 4.5
2.	Grasses,	1:5.0 to 1: 8.0
3.	Green corn, roots and tubers,	1:6.0 to 1:15.0

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, pease, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the economical systems of rotations, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops. Although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

FIELD "F" 1889.



SCALE, 4 RODS TO 1 INCH.

V. Notes on Miscellaneous Field Work.

Although the entire farm land of the station has been placed under a careful supervision, as far as records of manuring, modes of cultivation and proper selection of crops for cultivation are concerned, a considerable part of it is not yet engaged in a strictly experimental work. The course adopted in the management of some fields aims at a timely preparation for some definite experiment contemplated in the near future; in others, to fit them for an economical production of fodder crops for the support of farm live stock. The fields designed for the cultivation of fruit-bearing trees and shrubs, to study the causes and the character of the diseases they are frequently heir to, are subdivided, and each plat subjected to a systematic treatment with different kinds and forms of manurial substances. The outlines of the area selected for permanent meadows are better defined, and the condition of the lands improved, by underdraining and ditching; different portions of the meadows are stocked with different varieties of grasses, to test their adaptation and their economical value. The ploughed lands are subjected periodically, whenever practicable, to drill cultivation, in the interest of a clean culture.

As the work accomplished in this direction can be better appreciated when stated later on in connection with the different results secured, a mere enumeration of the principal field crops raised during the past season may suffice here.

Hay,	37 tons.
Rowen,	15 tons.
Corn for ensilage,	19 tons.
Carrots,	5½ tons.
Sugar-beets,	4 tons.
Barley, grain and straw,	5,750 pounds.
Oats, grain and straw,	5,350 pounds.
Corn on the cob,	5,250 pounds.
Fodder corn,	7,000 pounds.
Corn stover,	7,000 pounds.
Sorghum fodder,	2,000 pounds.
Vetch and oats (green),	5,450 pounds.
Cow-pease (green),	6,600 pounds.
Serradella (green),	8,350 pounds.

VI. Department of Vegetable Physiology.

1. — Report by Prof. James Ellis Humphrey.

The first year of my work in this department has been largely one of organization and equipment. Beginning without equipment and in limited quarters, no elaborate work has been possible. The liberality of the last Legislature has removed this difficulty, however, and the new building and green-house provided for the department are just completed and occupied. Views of the new accommodations are given with this report.

Our equipment for certain lines of work, especially for the study of fungous diseases of plants, is now fairly good, and reference collections are well begun.

My report for 1889 comprises the following divisions: —

1. A general account of the *Fungi*, with special reference to those which cause diseases of cultivated plants.
2. A report on studies of the potato scab, carried on during the year.
3. Notes on various diseases of plants, which have been more or less prevalent on the station farm the past season.
4. Notes on specimens from other sources, referred to the department for examination and report.

1. *General Account of the Fungi.*

The past few years have been marked, in the United States, by a rapidly increasing interest in the relations of the *fungi* to the plants which they attack, and by a growing appreciation of the dreaded *rusts*, *smuts*, *mildews*, *blights* and other fungous diseases, and of their economic importance. These troubles, once regarded as mysterious, unavoidable, "Providential" visitations, are coming to be generally understood to be simple, direct effects of natural causes, and, as such, open to study and amenable to treatment. With this understanding comes, naturally, a comprehension of the value and practical utility of the scientific investigation of fungous diseases in all their phases.

The writer on *fungi* for popular information, meets at the outset a difficulty not experienced by all scientific writers,

in the very nature of the *fungi* themselves. It is not easy to comprehend that organisms so small and so inconspicuous can possess such power for harm; and it is not easy for the layman to understand that, in spite of their minuteness, they pass through life-cycles as constant and as definite as those of the plants on which they grow. It seems, therefore, worth while to attempt a general sketch of the growth and classification of those organisms of a vegetable nature, which attack and cause diseases of plants cultivated for useful products or for ornament. This account may serve as an introduction to the present as well as to future publications of this station on the subject of plant diseases, and to familiarize the reader, once for all, with the use of certain technical terms which are essential to exactness of statement. For the use of such terms no apology is needed. Their seeming difficulty lies simply in their unfamiliarity, which, as with all new words, soon wears away through use; while their advantage over words already familiar is that they convey precise ideas, unmodified by preconceptions, and so greatly aid in clearness and definiteness of thought. The words printed in SMALL CAPITALS on the following pages may serve, also, as a general reference-list of technical or semi-technical terms, whose use is essential in treating of plant diseases, and whose meaning, here explained, will be assumed for the future to be understood by the readers of the publications of this station.

Any plant consists of one or more of the elementary plant-units, known as CELLS. A cell consists essentially of a mass of the semi-fluid living substance which is the basis of all life, usually surrounded by a firm membrane, known as the CELL-WALL. The simplest plants consist of a single cell each; but the higher plants, on the other hand, are made up of immense numbers of cells, intimately united. Every living plant requires, for the renewal of worn-out parts and the growth of new parts, a supply of the materials necessary to such renewal and growth. Since both the living matter and the wall of the cell consist of compounds of a highly complex chemical constitution, the plant must be furnished with substances which contain the necessary chemical elements, in such form as to be readily convertible

by it into vegetable tissue. Such substances constitute the real *food* of plants, in the same sense that what an animal eats constitutes its food; and both plants and animals find available food-supply only in *organic* substances. Inorganic materials can no more serve plants than they can serve animals as food; and just here a distinction must be made between the true food of plants and "plant food," so called in the discussion of fertilizers. We shall see later what is the relation to the plant of the latter, which consists essentially of inorganic substances.

Now, we know that an animal must obtain its food materials ready formed; that is, it cannot prepare the organic nutriment it requires from inorganic substances, but must obtain it from plants or from other animals. Here lies the important distinction between animals and *green* plants; for, in spite of the fact that, to most persons, the word *plant* carries with it the idea of greenness, it is by no means true that all plants are green. Green plants owe their color to the presence in their leaves and other green parts of a special pigment, known as leaf-green or CHLOROPHYLL. It may be added that some plants which are not green to the eye, yet contain chlorophyll, whose presence is hidden by some other masking pigment. The term "green plants" is here used, then, to designate all *chlorophyll-containing* plants, whatever their external appearance.

In chlorophyll we have the remarkable substance which bridges the gap between the inorganic and the organic. It is the one substance in nature on whose activity the continuance of all life depends. It alone has the power of forming organized food materials out of the elements of inorganic substances, but only under certain definite conditions. The green tissues of land plants receive water from the soil by way of their roots and stems, and absorb from the atmosphere the carbonic acid gas, or *carbon-dioxide*, which it contains in small proportion. These two simple inorganic compounds, water and carbon-dioxide, furnish the elements, *carbon*, *hydrogen* and *oxygen*, for the formation of certain organic compounds; and it is the peculiar property of chlorophyll, that, in its presence, and in its presence *only*, these elements are freed from their original combinations,

and recombined into such organic compounds; though these changes can take place only when the chlorophyll is exposed to light of sufficient intensity, and when the water supplied to it holds in solution suitable inorganic compounds containing *nitrogen*, *potassium*, *phosphorus*, *calcium*, *magnesium*, *iron* and *sulphur*. Under natural conditions, waters from any soil in which plants will grow will be found to contain all these substances; but, in consequence of repeated cultivation and removal of the crops, the supply of these materials in a soil becomes greatly reduced, or, as we say, the soil becomes "exhausted." It then becomes necessary to supply the lacking constituents to the soil in the form of manures or fertilizers; and it is these necessary elements which are commonly spoken of as "plant food." Being inorganic, they cannot serve as food to the plant; but, as we have seen, their presence is indispensable to the elaboration of the true food of the plant from the materials furnished by water and carbon-dioxide. The precise relation of most of these elements to the life of the plant is hardly at all understood; but it is easy to show that, in the absence of either of them, there can be no permanently healthy activity. Their relation to the elaboration of organic food material from inorganic compounds has been compared, perhaps aptly, to that of oil to the smooth running of a steam-engine.

The necessary conditions being fulfilled, then, there occurs a recombination of the constitutents of water and carbon-dioxide into organic substance, excepting a part of the *oxygen*, which is set free into the atmosphere. Whatever temporary combinations they may pass through, the first visible and stable form in which these recombined elements appear is usually that of *starch*, which is the commonest form of organic food material that occurs in plants. After it is thus provided, by the activity of its chlorophyll, with an organized food supply, the plant utilizes it, as it needs, for the formation of tissue, either in repairing waste or in new growth.

But not all plants contain chlorophyll. Very many resemble animals in being entirely unable to provide their own nourishment, and in being, therefore, wholly dependent on external sources of food supply. Since their food supply

consists of organic substances, it is evident that it must come from one of two sources; either from living organisms, animal or vegetable, or from dead organisms in a more or less advanced state of decomposition. Among flowering plants there are a few which are thus dependent, the best known of which are the white "Indian pipe" *(Monotropa)* of our woods, and the "Dodder," which twines its yellow or orange-colored leafless stems about our golden-rods and similar plants. But nearly all of the chlorophyll-less plants are of much simpler structure. They are mostly very small, and show no distinction of separate organs, like the stem and leaf of higher plants.

These simple plants may best be grouped under three heads, the true *Fungi*, the *Bacteria*, and the *Slime Moulds*. Many of them live on decaying organic matter, the remains of dead organisms of various sorts, and are known as SAPROPHYTES, or corpse-plants. Others, on the contrary, resemble the dodder in drawing their nourishment directly from living plants or animals, on which they are said to be PARASITES. The plant or animal at whose expense the parasite lives is called its HOST. It is this latter class of plants which has special interest to all who cultivate the higher plants, since its members cause the numerous and frequent plant diseases ordinarily known as *fungous* diseases. As we have seen, they attack their host plants for the purpose of obtaining the organic food supply necessary to their growth, which they are unable, from lack of chlorophyll, to provide for themselves.

The effects of different parasites on their host plants vary greatly. It is evident that the host plant must always be weakened by being robbed of a part of its food; but the amount taken seems, in some cases, to be insignificant, so that no serious damage results. On the other hand, the destruction of the host is sometimes so rapid and so complete that there can be no doubt that the parasite exercises a more positively fatal influence than merely that of turning the food supply of the plant from its proper channels. Between these extremes one may observe all degrees of harmfulness on the part of the various parasites; and the harm done by any particular one may vary widely in

different cases, being largely controlled by varying conditions.

The great majority of parasitic fungi develop and vegetate within the tissues of their hosts; but some forms live and grow superficially, merely sending small branches into the cells of their hosts, for the purpose of absorbing nourishment. These *external* parasites are, as a rule, much less injurious to the plants they attack than are *internal* parasites.

A striking influence is often exerted on the habit of growth of a plant by the attacks of a parasite. Thus, it is often possible to tell which among a number of plants are infected, by their appearing taller or shorter, or slenderer or stouter, than the healthy plants; or they may appear of a lighter or darker shade of color; or, as frequently happens, the development of a fungus in the tissues of a plant may cause the affected parts to become abnormally developed and distorted to such an extent as to attract the attention of even the casual observer.

Just here should be noted an important fact for the student of parasitic fungi. As a rule, a given parasite is able to live on only a single host species, or on a few closely related species, seeming to require for its development the special chemical and other conditions afforded by some particular plant or particular group of similar plants. But, on the other hand, closely related parasites may attack widely different plants. For example, there is a very common "rust" which attacks the Canada thistle, and another which is equally common on grasses and grains. The two rusts are very closely related, while the relationship between the thistles and the grasses is very remote. Neither of these rusts can live on the host plant of the other.

The distinction between parasites and saprophytes, while very useful, must not be made too strict; for there are numerous fungi which, while naturally saprophytes, can assume the role of parasites under certain conditions, and others which may live as saprophytes, for a time at least, though ordinarily obtaining their nourishment parasitically. Many fungi, also, are probably parasites in some and saprophytes in other parts of the life-cycle.

We may pass now to a more particular account of the groups of chlorophyll-less plants already mentioned.

The Slime Moulds comprise a comparatively small number of plants, most of which are strictly saprophytic in their mode of life. A few of the simpler ones, however, are parasites, and their life history may be briefly sketched. They pass the winter or other unfavorable period in a so-called resting state, in which condition they appear as tiny globular bodies, each consisting of a mass of living matter, surrounded by a tough, firm coat. When warmth and moisture return, these outer coats crack open, and the living masses escape and begin to actively creep about, seeking for the plants on which they are able to live. Failing in this search, one of these tiny creeping masses soon dies; but, if successful, it penetrates the cells of the host plant, and proceeds to grow and mature at its expense. Toward the end of the growing season, the masses of living substance, which have greatly increased in size and now occupy the interiors of cells of the host whose contents they have absorbed, break up into many very small portions, each of which enters the resting state by becoming surrounded with a tough coat, and so awaits the next season. These organisms are clearly of the simplest nature, and it would perhaps be better to call them simply *organisms*, than to try to assign them a place on either side of the shadowy and indefinite line which separates the lowest plants and animals. By nearly universal consent, however, their study is assigned to the botanists. The most important member of this group, economically, is perhaps the parasite which causes the "club-foot" of cabbages and turnips, incidentally described in the article on "Potato Scab," in the report of this station for 1888.

The Bacteria, or "germs," include the smallest known organisms, with both saprophytic and parasitic forms, and perhaps many which can live in either way. They consist of minute spheres, rods and threads, whose vital activity is the cause of many most remarkable phenomena. Among those which live saprophytically, one form produces the putrefaction of dead organic matter; another causes the souring of milk; another, the change of alcohol into acetic

acid, which occurs when cider is converted into vinegar; another produces the rancidity of butter; and so on, through a long list. Many of the parasitic bacteria live in the bodies of men or other animals, and produce the most dreaded and dreadful contagious or *zymotic* diseases, like small-pox, anthrax or splenic fever, diphtheria, Asiatic cholera, hog cholera, Southern cattle fever, chicken cholera, pleuro-pneumonia, and many others. A few, also, produce diseases of plants, especially the rotting of bulbs and tubers. It is also claimed by careful investigators that the "fire blight" of pear and apple trees is due to the attacks of one of the bacteria.

These plants reproduce themselves chiefly by *fission*, a process which consists in the elongation of the organism up to a certain point, and the formation of a cross-wall dividing it into halves, which then separate and become independent. In its essentials the process is evidently a simple cutting in two.

The bacteria are universally disseminated, since their extreme smallness and consequent lightness render them easily transportable by the lightest breezes. When it is remembered that all putrefactive changes are due to their activity, their omnipresence begins to be realized.

The true FUNGI show greater complexity of structure than either of the groups just described. With a very few exceptions, they have a distinct *plant body* or vegetative portion, on which are developed the reproductive organs, or fruiting portion. The plant body consists of fine colorless threads, often branched, which spread over or through the substance from which the fungus draws its nourishment. These active, absorbing, vegetative threads of the plant body constitute the MYCELIUM of the fungus. From these are ultimately produced others, which are the fruiting or reproductive threads of the plant, and bear the reproductive bodies whose function is similar to that of the seeds of the higher plants, namely, the perpetuation of the species. Though produced in widely different ways, and varying among themselves far more than do the seeds of flowering plants, they may be, for convenience, all included under the general name SPORES. They are much simpler in

structure than true *seeds*, and are usually microscopic in size.

In the simplest cases, the spores of a fungus are produced directly on the ends of separate and independent fruiting threads; in other cases they are the products of sexual processes, involving the union of distinct male and female threads; and, in the more complicated forms, numerous reproductive threads become intimately interlaced and compacted into a fruiting structure, often of considerable size, which bears spores in an interior cavity or cavities, or on some part of its surface. These spore-bearing structures reach their greatest development and conspicuousness in the "toadstools" and related fungi. In the modes in which spores are developed from the fruiting threads, we may distinguish two chief types. In one case, the end of a thread is simply cut off to form a spore; while, in the other, the end of the thread swells, and spores are formed free in the swollen portion. Those of the former type may be called *naked*, those of the latter, *enclosed*, spores. There is another classification of the spores of fungi, which is of special importance in the study of plant diseases. The majority of fungus spores can germinate at once and produce new fungi, under favorable conditions for vegetation. Of these there are some which live but a short time, and, unless they very soon find such conditions, fail to develop. They are produced in great numbers, however, may develop rapidly, and serve especially to spread the fungus by the infection of new hosts during the growing season. They may therefore be designated SUMMER SPORES. A familiar example is offered by the spores developed in red-brown streaks on the leaves and stalks of grain, in midsummer, and known as the "red rust." Other spores can live for a long time, awaiting suitable conditions, and ready to improve the first opportunity for germination. Still others, on the contrary, require a greater or less period of rest or quiescence before germination can take place. Such spores are usually able to withstand great extremes of temperature and dryness, and serve to perpetuate the plant through the winter or other unfavorable period; in contrast to the summer spores, which spread it rapidly at favorable seasons. They may be distinguished as RESTING

SPORES, and well illustrated by the spores which compose the black streaks which follow the red rust on the stalks of grain, and are known as "black rust."

A few fungi form peculiar bodies, which serve the purpose of resting spores, although they are of a very different nature. These are dark-colored masses of closely compacted mycelium, which can retain their vitality for a long time under circumstances unfavorable to growth, and finally, when favorable conditions recur, produce spore-bearing structures and spores. These special resting mycelia are known as SCLEROTIA, and are well illustrated by the *ergot* of grain, often known as "spurred rye."

A given species of fungus may produce, not merely one but two or several forms of spores and spore-bearing structures. These various forms may be produced at the same time or at nearly the same time, on the same mycelium; and, when this is the case, their connection and relations to each other are comparatively easy to make out. For instance, the streaks of rust on the culms of grain may often be found, at the proper season, with both red and black spores arising from the same mycelium, showing that the red and black rusts are only different spore-forms of the same fungus. But so simple a condition as this is the exceptional rather than the usual one. In very many fungi, the spores produced on one mycelium develop other mycelia essentially indistinguishable from the first, on which spores very unlike the first are formed; and these may, in their turn, give rise to a mycelium bearing spores like the first. For example, the mycelium developed next spring from the spores of many black rusts of the present season will produce, not new rust spores, but chains of wholly different spores, arranged in the form of tiny circular masses, each surrounded by a fringed or ragged border. From this characteristic structure, and the fact that they usually grow in close groups, these peculiar forms of fructification have received their name of *cluster cups*. On the mycelium arising from their spores are developed again rust spores like those which gave rise to the cluster-cup mycelium. Or again, the same mycelium may produce two or more forms of spores at quite different times, so that their connection is not directly traceable except by keeping

the mycelium under long-continued observation. The spores and spore-bearing organs in the different stages of the same fungus may represent wholly different types of structure; so that the different forms have been, and, in the great majority of cases, still are, described and known under different names, as distinct fungi. This diversity of form, characteristic of the life-cycle of so many fungi, is known as PLEOMORPHISM. The subject is but just beginning to be understood, and its study is only begun. Consequently our knowledge of the whole matter is extremely fragmentary and unsatisfactory.

The fungi, like other plants, exhibit among themselves widely different types of structure, and may be separated into very distinct groups; while, within the limits of these groups, they show in greater or less degrees that similarity of organization and development which indicates descent from common ancestors, and consequent near relationship. These likenesses and differences enable us to arrange the fungi for convenience of study and discussion in a more or less natural order, though our knowledge is still very far from being sufficiently complete to afford us an arrangement which at all fully represents their relationships. It will be a great convenience, in future discussions, to have a general outline of the classification of the fungi and related groups; and the following is presented with a view to meeting this need. It is hoped that it may prove useful for reference, and sufficiently full, taken in connection with the preceding general account, to facilitate an intelligent understanding of discussions of particular fungous diseases. If any reader should feel, after reading this necessarily very brief and imperfect sketch, a desire for more detailed information concerning any fungi, the writer will be glad to render all possible assistance. In the following brief accounts of the various groups, attention has been given especially to those which include parasites on cultivated plants. The best available English name has been given to each group, and after the English name will be found, in each case, the name, in parentheses, by which the group is known to botanists.

I. Slime Moulds (*Myxomycetes*). — See above, p. 201.

II. Bacteria (*Schizomycetes*). — See above, p. 201.

III. Fungi. — These may be conveniently divided, for our purpose, into about seventeen groups, all but the last composed of quite closely related plants, as follows: —

1. *Downy mildews* and *white rusts* (*Peronosporeæ*) are internal parasites in the herbaceous parts of plants. Most of them produce summer spores, on threads which break through the surface of the plant into the air; and resting spores, in the interior of the host. The latter are set free by the decay, during the winter, of the tissues in which they are imbedded, and then germinate in spring. The former are scattered by the currents of air, and rapidly infect new hosts.

Among diseases caused by attacks of members of this group of fungi are the potato rot, downy mildews of the grape, lettuce, onion, etc., and "damping off" of seedlings.

2. *Water moulds* (*Saprolegniaceæ*) are chiefly saprophytes on animal substances (dead insects, etc.) in water; but one of them can attack living fish, notably the salmon, destroying the skin, commonly of the head region, by its gradual spread, and finally killing its victim.

3. *Leaf-gall fungi* (*Chytridiaceæ*) are very small and simple parasites, some of which form pustule-like swellings of herbaceous parts of flowering plants, and so merit the name here given. A majority of the members of the group, however, are parasites on the lower water plants, and of no present interest.

4. *True moulds* (*Mucorini*) comprise fungi which are saprophytes on common vegetable substances, and others which are parasites on the mycelia of the former. They are of no special interest in the present connection.

5. *Insect fungi* (*Entomophthoreæ*) are nearly all parasites of insects, and cause the death of their hosts. Their only economic interest is in the possibility which has been suggested that they may be artificially propagated for use in destroying insect pests. The cheme however is one of very doubtful practicability.

6. *Smuts* (*Ustilagineæ*) are internal parasites of flowering plants, and develop both mycelium and spores in the

tissues of their hosts. The mycelium is largely used up in the formation of spores, so that, at maturity, little is to be found but a dark-brown or black powdery mass of spores. In most cases these latter can germinate at once under certain conditions; but they may live for a very long time ready to germinate when favorable conditions occur. The spores of some smuts seem to be true resting spores; and those of many other species approach that condition, in that they germinate much more readily after a period of rest than when just mature. The smuts of corn, of wheat and other grains, and of the onion, are only too well known.

7. *Rusts* (*Uredineæ*) are especially interesting for their striking and remarkable pleomorphism, already referred to. They are very common parasites of flowering plants, and the typical species produce three chief spore forms. Individual variations within the group make it difficult to give a general account, but the following will apply to most of the rusts. Early in the season the fungus appears in its first or *cluster-cup* stage, described above, and shown in the yellow patches so common on barberry leaves in June. The spores of this form produce fresh mycelia, which give rise to the second, and later to the third, spore form. These second and third forms, are, as has been already stated, the *red* and *black* rusts, respectively. This is the typically complete condition, but in very many cases one or even two of the forms are unknown. The spores of the *cluster-cup* and *red-rust* forms are summer spores, while those of the *black-rust* are usually resting spores, though not always so.

Frequently the various forms of a rust fungus follow each other on the same host plant; but the difficulty of a complete knowledge of many of them is further complicated by the fact that the *cluster-cup* form occurs on one host, and the other two on a widely different one. For example, the cluster-cup of the barberry is the first stage of the fungus whose second and third stages are the red and black rusts of wheat and various other grains and grasses, as has been shown by careful and repeated cultures. This form of pleomorphism, in which the different spore forms of a parasitic fungus occur on different hosts, is known as HETERŒCISM.

A few closely related plants belonging to the group of rusts constitute important exceptions to the typical life history, outlined above. These are *heterœcismal* fungi, whose second form is unknown, and probably does not exist. Their cluster-cup forms cause the familiar "rusting" of the leaves, and sometimes of the fruits, of apple trees, hawthorns and related woody plants, in summer; and their third forms are the "cedar apples," whose gelatinous fruiting masses are equally common on our red cedars or "savins" and junipers, in spring. It will be seen from the above that the "cedar apples," which correspond to the *black-rust* stage of other rusts, appear *earlier* in the season than the *cluster-cup* stage; naturally, then, their spores are not resting spores, the fungi being carried through the winter by their mycelia, which live in the branches of the hosts.

Among important isolated forms, whose other stages are unknown, may be named the orange-colored rust which covers the lower surfaces of the leaves of blackberries and raspberries in spring and summer.

8. *Jelly fungi* (*Tremellini*) are very interesting botanically, since they show distinct relationships with both the rusts and the toadstools; but they are saprophytes, and require no further notice here, beyond the statement that they form gelatinous masses of various colors, from white to black, on dead wood, and are most abundant in late fall and early spring.

9. *Toadstools* (*Hymenomycetes*) are perhaps the most abundant of fungi, besides comprising more species than any other group. They are nearly all saprophytes, and many grow in places where the presence of organized food material would hardly be suspected. Their spores are borne free at the ends of spore-producing threads, which are usually packed closely together, and form a fruiting surface. In the simplest members of the group this surface is the only one exposed to the air; but in the more elaborate forms, popularly known as toadstools, there are upper and under surfaces distinguishable on the fruiting structure, and of these the latter is the spore-producing surface.

A few forms are of present interest. One of the simplest members of this group causes the leaves and fruits of the

blueberry, cranberry, and related plants, to become swollen and covered by a white "bloom," composed of the spores of the fungus, and often does considerable damage. The mycelia of several toadstools grow in the wood or between the wood and bark of trees, and may do much harm to timber. In the case of some species, the mycelia may form long, brown, branching *sclerotia*, somewhat resembling roots, which are not uncommon beneath the bark of decaying logs. This group includes the mushrooms, the chantarelle, and many other valuable food fungi.

10. *Puff-balls* (*Gasteromycetes*) are nearly related to the last group, and, like most of its members, are saprophytes. A few of the species are edible, but otherwise the group has no economic importance, although including many familiarly known forms.

11. *Yeasts* (*Saccharomycetes*) are very simple fungi, in which the plant is reduced to a single elliptical cell, and reproduces itself chiefly by a process of budding. A slight projection grows out from the cell, and gradually increases in size until it reaches dimensions not much less than those of its parent cell, from which it then becomes detached, and begins to lead an independent life, budding in its turn. Although saprophytes, these fungi are of great interest economically, from their producing the alcoholic fermentation, and their consequent practical application in baking and brewing. The change known as alcoholic fermentation consists in the separation of the chemical elements composing *sugar*, and their recombination into other compounds, chiefly alcohol and carbon-dioxide; and the power to produce this change is possessed in a remarkable degree by some of the yeasts.

12. *Leaf-curls* (*Exoasceæ*) are parasitic fungi of very simple structure. They cause a swelling and curling of the parts attacked, which are commonly the leaves, though sometimes the fruits. The distortions are covered by a "bloom" composed of tiny club-shaped sacs, projecting from between the surface cells of the host, and containing minute spores. The "curl" of peach leaves and the swelling of unripe plums into "plum pockets" are caused by these fungi.

13. *Powdery mildews* (*Perisporiaceæ*) are external parasites of herbaceous parts of plants. The white threads of the mycelium spread over the surface, sending absorbing organs into the tissues, and bear abundantly the fruiting structures, which are recognizable by the naked eye as tiny black bodies, when ripe. Each of these bodies consists of a hard shell, surrounding from one to several somewhat egg-shaped sacs, in which the spores are contained. The best-known of these fungi are the powdery mildews of the grape and the gooseberry.

14. *Black fungi* (*Pyrenomycetes*) may be so called from the fact that a large majority of them produce a blackened, carbonized appearance of the leaves or branches which they attack, making them look as though burned. Sometimes, however, they are of a light or bright color, so that the name is not entirely appropriate. In cavities in these black or colored fruiting structures are contained the spores, enclosed in oblong or club-shaped sacs, which escape into the air through tiny pores connecting with the exterior. Many of these fungi also produce summer spores, on threads which cover the outer surface with a "bloom," or line cavities similar to those which contain the spores in sacs. Most of these plants are saprophytes, but a few attack hosts still living. Of them there are a few which are too well known, notably those which cause the "black-knot" of plum and cherry trees, and the "black-rot" of the grape.

15. *Saucer fungi* (*Discomycetes*) are so called from the form of the fruiting portion of many members of the group, though, on account of their wide variations, no single descriptive term is applicable to all. They are chiefly saprophytes, and the larger forms sometimes strikingly recall the toadstools in habit and place of growth. The spores are contained, as in the last two groups, in closed sacs, which, in the saucer fungi, stand erect and closely packed together on the upper or inner face of the saucer, which they cover with a distinct spore-bearing layer. A few of these fungi live, at least under certain conditions, as parasites, and develop small *sclerotia* in the tissues of their hosts, thus producing the so-called "sclerotia diseases" of clover, onions, hemp, etc.

16. *Truffles* (*Tuberaceæ*) are a small group of subterranean saprophytes, some of which are highly prized as articles of food.

17. *Imperfect fungi* is a general term to include an immense number of forms supposed to be mostly early stages in the development of members of some of the groups already described, especially various summer-spore forms of fungi belonging to groups 13, 14 and 15. Here are comprised the very different forms known under the names *Sphæropsideæ*, *Melanconieæ*, *Hyphomycetes*, etc. The spores are usually borne naked on the ends or sides of spore-producing threads, and germinate at once, as a rule. These fungi are, in large proportion, parasites, and produce diseases of widely differing external appearance, known variously by the names "anthracnose," "blight," "spot," "scab," "rot," etc.

A fuller account of these fungi is impossible, except by subdividing them into several groups, because of the very heterogeneous character of the contents of this general *catch-all* for forms not placed elsewhere. The fact that such a miscellaneous and enormous collection of "imperfect" form-species must form a part of any enumeration of fungi, is the best evidence of the incompleteness of our knowledge. In proportion as that knowledge increases, the extent of this collection must diminish.

The above outline covers the principal fungi, and will, it is hoped, to some extent subserve the purposes for which it has been prepared. Being now in possession of some general facts concerning fungi, we may attempt to deduce from them some of those principles which must guide us in attempts to lessen or prevent the ravages of diseases caused by these plants.

Since parasitic fungi develop, for the most part, within the tissues of their hosts, it is evident that there is little possibility of saving a plant once fairly infected; for what would kill the parasite would ordinarily be fatal to the host. The powdery mildews, being external parasites, may perhaps be killed after they are well developed. Our chief aim, however, must be to protect the plant by the thorough application to its exposed surfaces of some preparation which

shall, without injuring the plant, kill or at least prevent the germination of fungus spores which may alight upon it, and which would, under natural conditions, germinate there and infect the plant. Many such preparations have been proposed and tested, a few with encouraging results. While this whole subject is but little developed as yet, two formulæ may be given which promise to be quite generally useful: —

Copper Mixture of Gironde or Bordeaux Mixture.

A. Dissolve six pounds sulphate of copper (blue stone) in sixteen gallons water.

B. Slake four pounds quicklime with six gallons water.

C. When cool, mix *A* and *B*, stirring thoroughly.

Blue Water or Eau Celeste.

Dissolve one pound sulphate of copper in four gallons warm water; when cool, add one pint commercial ammonia and eighteen gallons water.

The latter of these may be applied by means of any apparatus which thoroughly distributes it; but the former requires the use of a spraying pump, with a special agitating nozzle to keep it evenly and thoroughly mixed, since the lime is simply held in suspension, without being dissolved.

It seems hardly necessary to point out that a vigorously healthy plant will be far less subject to the attacks of fungi, and will suffer far less from such attacks, than a poorly nourished one. Both theory and experience point to this obvious conclusion.

After a plant is too far gone to be saved, measures should be taken to prevent the infection of neighboring plants, still intact, and of plants of the same kind, in the following season. With the latter object in view, one should destroy the affected parts, and especially any dead or fallen parts or refuse, which may harbor the spores of the fungus during the winter. In dealing with fungi which produce resting spores, these precautions should be taken with especial thoroughness. The destruction of infectious material should be as complete as *burning* can make it, for nothing less than this will assure the death of all the spores contained in it. In dealing with any fungous disease, one of the secrets of success may be summed up in the word, *thoroughness.*

Numerous cases can be cited of common weeds or wild plants, each of which is so closely related to some species of cultivated plants that it is liable to attack by the same fungi that infest its cultivated relative. Where this is true, the wild plant may serve equally with the cultivated one to perpetuate the fungus, and may keep it alive during a time when the latter is not grown, or may become a source of infection for a cultivated field, previously free. For example, the "black-knot" fungus grows on our wild cherries, as well as on cultivated cherries and plums; the lettuce mildew occurs on several species of "wild lettuce;" and the grape-vine mildew, besides occurring on wild grape vines, has been found on the Virginia creeper. The bearing of these facts on questions of preventing and checking the various diseases is obvious.

Finally, it is clear that epidemic diseases cannot be successfully combated without general co-operation throughout an infected region. The attempts of half a dozen intelligent men to protect their crops may be almost of no avail, if one lazy or "conservative" neighbor refuses to join in the attempt, and allows his adjacent field to afford a breeding-place for the very fungus our progressive friends are fighting.

Successful dealing with diseases caused by parasitic fungi may be said, then, to be based on the following essentials: *promptness*, *thoroughness*, *cleanliness*, *intelligent treatment*, *co-operation*.

The writer wishes to come into much more general communication with the farmers, market gardeners, horticulturists, florists, and all who cultivate plants, in the State. He especially and urgently requests that specimens be sent him of plants affected by any disease, not caused by insects, which may come to the attention of any reader of this report.

Very much aid to a fuller knowledge of many diseases can be afforded if those who are the losers by them will co-operate to render all possible assistance, even to the extent of going to some trouble, to those engaged in their study. Without such co-operation and assistance, our work must necessarily be far less effective and our studies far less complete in their results.

2. *The Potato Scab.*

In the report of this station for 1888, pages 131 to 138, was given an account of the disease of potatoes known as "scab," with a summary of the views held up to that time as to its nature and cause. It was shown that, while the characters of the disease are sufficiently marked and far too familiar, its cause is still to be explained. On this point three principal theories are held, which may be stated briefly as follows: (1) the theory of W. G. Smith and others, that the trouble is caused by the irritating action of foreign substances in the soil; (2) the view that it is due to peculiar soil conditions; and (3) Brunchorst's claim that it is caused by the attacks of a parasite belonging to the slime moulds. Various American experiments were quoted, bearing on the effects of the presence or absence of manure, excess or deficiency of water, use of smooth or scabby "seed," use of fungicides, and cultivation of light or dark skinned potatoes.

In the spring of 1889, arrangements were made for experiments on the same plot on which the scab had appeared for several years, — Field E, containing about three-tenths of an acre. This plot, which had been ploughed the previous fall, was ploughed again in the spring, and divided into twenty-eight sections of three rows each, the section being regarded as the unit, and each section being treated, as nearly as possible, in a uniform manner.

The whole plot, excepting section 1, at the south end, was dressed with an application of ground bone and potash-magnesia sulphate, at the rate of 600 pounds of the former and 290 pounds of the latter per acre. In addition to suggestions for the details of experiments drawn from current theories and previous experiments, two were adopted from other sources; namely, to test the effect of tobacco applied in the drill in the form of ground tobacco refuse, and to observe the results, as to the development of scab, of deep planting. Arrangements were made to facilitate the irrigation of a part of the sections; but, owing to the extreme rainfall of the season, no use was made of the means provided, and no comparison of the effects of excess

and deficiency of moisture on the development of the scab can be instituted, as the whole field received the same liberal natural watering.

The first five columns of the following table show the details of the planting of each section. It will be seen that the plan affords material for the following comparisons of results, as to the development of scab: 1. Deep *vs.* shallow planting; 2. Susceptibility to attack of light and dark skinned varieties; 3. Barn-yard manure *vs.* commercial fertilizers; 4. Effect of tobacco dust in drill; 5. Scabby *vs.* smooth "seed."

Number of Sect.	Quality of Seed.	Variety of Seed.	How Fertilized.	How Planted.	Scabbiness of Crop.
1	Smooth,	Beauty of Hebron,	Barn-yard manure,	In hills,	Very badly scabbed.
2	"	" "	Bone and potash,	In drill,	Considerably scabbed.
3	"	" "	" "	"	Considerably scabbed.
4	"	" "	" "	"	Badly scabbed.
5	"	" "	Bone, potash and tobacco,	"	Badly scabbed.
6	Scabby, except bl'k,	1st and 2d rows, Beauty of Hebron; 3d row, $\frac{1}{2}$ white, $\frac{1}{2}$ black,	Bone and potash,	"	Badly scabbed, except bl'k.
7	Scabby,	1st row, Beauty of Hebron; 2d and 3d rows, white,	" "	In trench (deep),	Considerably scabbed.
8	Smooth,	Beauty of Hebron,	" "	In trench,	Somewhat scabbed.
9	"	" "	" "	In drill,	Badly scabbed.
10	"	" "	" "	"	Considerably scabbed.
11	"	" "	" "	"	Considerably scabbed.
12	"	" "	" "	In trench,	Considerably scabbed.
13	Scabby,	1st row, Beauty of Hebron; 2d and 3d rows, white,	" "	In drill,	Considerably scabbed.

14	Smooth, . .	Beauty of Hebron, . . .	Bone, potash and barn-yard manure, ...	In hills, . .	Very badly scabbed.
15	" . .	" " . . .	Bone and potash, . .	In drill, . .	Badly scabbed.
16	" . .	" " . . .	" " . .	" . .	Badly scabbed.
17	" . .	" " . . .	Bone, potash and tobacco, .	" . .	Badly scabbed.
18	" . .	" " . . .	Bone and potash, . .	" . .	Considerably scabbed.
19	" . .	Polaris, ...	" " . .	" . .	Considerably scabbed.
20	" . .	"	" " . .	" . .	Badly scabbed.
21	" . .	Beauty of Hebron, . . .	" " . .	" . .	Considerably scabbed.
22	" . .	" " . . .	" " . .	" . .	Considerably scabbed.
23	" . .	Polaris, ...	" " . .	" . .	Considerably scabbed.
24	" . .	"	" " . .	" . .	Considerably scabbed.
25	" . .	"	" " . .	In trench, . .	Somewhat scabbed.
26	" . .	"	" " . .	In drill, . .	Somewhat scabbed.
27	" . .	"	" " . .	" . .	Considerably scabbed.
28	" . .	Beauty of Hebron, . . .	" " . .	" . .	Considerably scabbed.

The scabby "white" potatoes planted on sections 6, 7 and 13 were of a very light-skinned sort, much resembling the Gregory, though not certainly of that variety. Those called "black," planted on section 6, were a very few small, elongated, dark-purple tubers, found in the station barn; the "tops" showed the same dark color which marked the tubers, and produced the only entirely smooth potatoes on the field. The plot was planted May 4, and the first shoots broke through the soil on the 17th. A week later they were well up, and a marked backwardness of sections 1 and 14 was observed, as compared with the rest. The retarding effect of planting directly on manure continued to be distinctly noticeable for three weeks longer. Various explanations may be offered, however, for this fact, which, by itself, has no special significance. The field was cultivated and hoed at sufficiently frequent intervals, and the plants grew well, being kept fairly free from the potato beetle by two light applications of Paris green, combined with hand-picking.

On the 4th of June young tubers were found, of the size of a pea, and from this time their size and number rapidly increased. On July 22 the first indications of the *rot* made their appearance on the leaves of some plants near the south end of the plot, and had soon spread over almost the entire field. As soon as possible, namely, on the 29th of July, the potatoes were dug, in order to avoid the loss of results from the scab experiments to which the rotting of the tubers would lead. The potatoes from each section were kept distinct, and carefully examined with reference to their relative scabbiness. The result in each case is briefly stated in terms of a scale of five grades, running from "generally smooth" to "very badly scabbed," in the last column of the foregoing table. A compilation of the results there given, with regard to their bearing on the points before indicated, shows that: 1. Deep planting appears to tend to diminish the development of scab, though further experiments in this direction are very desirable. 2. While the very dark potatoes were wholly free from scab, little or no difference was to be noticed in the susceptibility of the three light varieties planted; it is to be regretted that none of the best

red varieties were available for the comparison. 3. The potatoes raised on barn-yard manure were markedly more scabby and more deeply scabbed than the rest. 4. Tobacco dust in the drill had no appreciable effect in increasing or diminishing the scab. 5. Scabby "seed" produces a crop neither better nor worse than that grown from smooth potatoes. None of these results are new, but they may serve as further material on which to base general conclusions, and as confirmatory of the results of most previous similar experiments. But all such results are comparatively without significance, so long as the *cause* of the trouble remains unknown, and we are as much as ever in the dark, so far as any basis of rational experimentation or treatment is concerned; therefore the most attention has been given to the study of the development of the scab.

From the time when tubers began to be formed till the crop was dug, plants were taken up at intervals, and carefully examined. The first suspicious spots were found on some small tubers June 20, and the first unmistakable scab was noticed on the 28th. After this time abundant specimens were obtainable. It is worthy of note that the first examples of affected tubers were obtained from sections 1 and 14, on which barn-yard manure was used, and that they always furnished the most and scabbiest material.

The scab always begins in very small spots, and spreads from these. When quite small, the spots usually show dark-brown centres from which the lighter marginal portions seem to have spread. These dark central spots mark the position of the *lenticels* of the tuber, in which the disease originates. The microscopic structure of the diseased spots is the same at all stages of their development. The first suspicious spots, detected June 20, on very young tubers, proved, on microscopic examination, to be young scab-spots, and could not be distinguished in minute structure from the large patches on a full-grown tuber. The characteristic change which produces the appearance and condition known as *scab* consists in the browning, drying and shrivelling of the walls of a few layers of the surface cells of the tuber, which produces a hard and rough crust. The difference between a very small spot and a large patch of scabby surface

is wholly one of kind, the latter developing from the former by the simple extension of the pathological condition described, over a greater surface. In this way is produced what may be described as the *superficial* form of the disease, illustrated by the lower specimen in Fig. 1, opposite page 136 of our report for 1888, and by Fig. 1, accompanying the present paper. The drying and browning sometimes penetrates to a considerable depth, and causes the death of masses of tissue of some volume, which finally become destroyed by decay, frequently with the assistance of worms and other animals. Their presence in this form of the disease has apparently led to the belief, held by many persons, that such animals are the cause of the trouble. This may be called the *deep* form of the scab, and shows, in its completest development, extensive cavities in the tubers, where tissue has died and decayed. It is illustrated by the upper specimen in Fig. 1 of last year's report, and by the accompanying Fig. 2. Both forms of the disease coexist under various conditions to such a degree that the causes determining the development of the deep form are wholly indefinable.

Very careful examinations were made, to determine whether the present disease is caused by any plant or animal, either as a true parasite or otherwise; but no organism of any sort was found constantly or even frequently present at any stage of its progress, and there can be no doubt that it is *not* the result of the activity or development of any living thing other than the potato plant. Various experiments, referred to in the paper in last year's report, above mentioned, have pointed to this conclusion, and their results would be very puzzling had the present investigations resulted otherwise. The search for some organism standing in causal relation to the trouble, has, however, been conducted with much care, in deference to the claims and theory of Brunchorst, quoted above, and to be discussed later.

Since the scientific name of an organism indicates always a definite and determinable thing, one can always be sure, in the study of a disease plainly caused by a plant or animal, as to the validity of his comparisons of his results with those of others who have studied the same disease. But the

words "scab," "Schorf" and "Skurv" are not terms which mean only definite things, but are of popular and general application; and the assumption that they are used in different countries to designate the same disease, remains merely an assumption until it is proved by direct comparison to be correct. Indeed, the assumption that the word "scab" is used, throughout our own country, for the same affection, is, perhaps, hardly justified; but, as it is borne out by specimens from various parts of New England, its correctness for the whole country is taken for granted. In order, however, to settle the uncertainty whether the three words above quoted are synonymous, two leading writers on the subject were requested to furnish material for comparison with American *scabby* potatoes. Dr. Sorauer, director of the experiment station at Proskau, Germany, was asked to send potatoes affected with the disease known in Germany as "Schorf" or "Grind," and Dr. Brunchorst of Bergen, Norway, to send potatoes attacked by the disease known in that country as "Skurv," and said by him to be caused by a species of slime mould. Both very kindly responded, and the writer wishes here to extend to both botanists his very sincere thanks for their interest and assistance.

Dr. Sorauer sent several tubers affected with what, to the naked eye, resembles in all respects our *superficial* form of scab; and microscopic examination fully establishes its identity with our disease. The accompanying Fig. 3 is made from a photograph of one of the potatoes sent by Dr. Sorauer. The German "Schorf" and the English "scab" are, then, synonyms, as applied to diseases of the potato.

From Dr. Brunchorst, a photograph of tubers attacked by "Skurv" has been received; but, unfortunately, the specimens of such tubers, promised by him, have failed to arrive, and it is impossible to accurately compare the disease with our own. Such comparisons as are rendered possible by Dr. Brunchorst's descriptions and figures and by the photograph he has had the goodness to send, point, however, to the conclusion that he is dealing with a disease very distinct from the *scab*, and that his assumption that the American and German diseases are identical with the Norwegian, is incorrect.

Fig. 4 is a reproduction of Brunchorst's photograph. Until more positive evidence can be obtained from the study of specimens, it seems safest to assume that the "Skurv" studied by him is quite different from the other diseases, and of different origin. This view removes difficulties not readily explained otherwise.

Bulletin No. 34 of this station, published last June, contained a series of questions concerning potato scab, addressed to farmers, especially those of this State, which they were requested to answer from their experience, for the assistance of this department in the study of the disease. Some ten thousand copies of this bulletin were sent out, and some agricultural journals showed their interest by printing and calling attention to them. The replies to this widely circulated request were *six* in number, and, of these, *four* came from neighboring States. It is fair to ask the farmers of Massachusetts to imagine how great is the encouragement derived from such a result by those who are working in their interest, and wish their co-operation and assistance. The facts stated require no comment.

In conclusion, it may be remarked that the results of the year are more negative than positive. It is certain that our disease is the same as that discussed by German writers, and that it is not caused by any parasitic organism.

Several years' observations at this station point, also, to the correctness of the view that the cause of our trouble is to be sought in peculiar physical or chemical conditions of the soil, though the opinion that excessive moisture is a sufficient controlling cause seems hardly tenable.

It seems to be generally conceded that potatoes become most scabby in heavy, close soil, and least so in light, loose soil; that worse crops in this respect are raised on land which has been cultivated for some time than on freshly broken ground. Indeed, the belief is quite general that new soil will give a smooth crop. This was not the case, however, at this station, the past season, when land broken for the first time in years gave a badly scabby crop. It should be added that this was on a stiff, heavy, poorly drained soil.

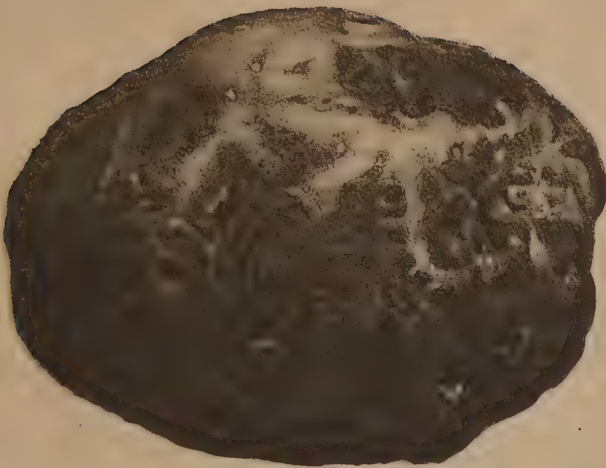


FIG. 1.

"Surface" Scab, from Station Plots.

FIG. 2.

"Deep" Scab, from Station Plots.

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FIG. 3.

German *Schorf* (="Surface" Scab.)

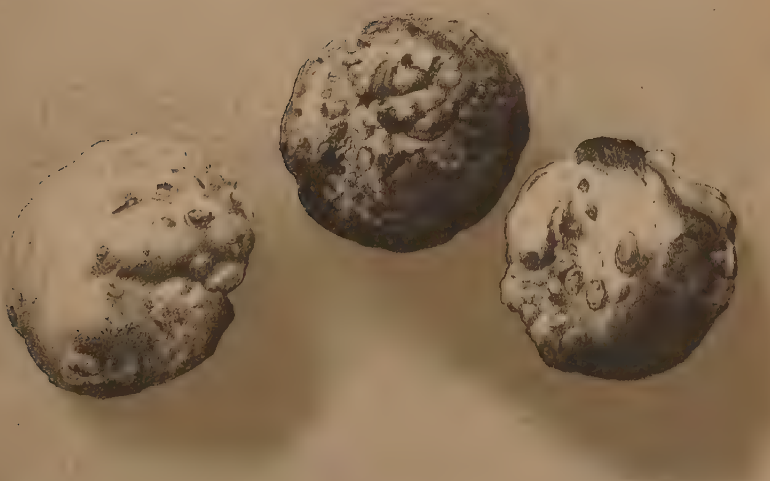

FIG. 4.

Norwegian *Skurv.*

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It seems at present probable that excess of moisture tends to produce the scab, rather through its influence in rendering the soil heavy and clinging, than in any more direct way; and it is recommended that, to secure a smooth crop, potatoes be planted in light, porous soil, kept well stirred.

Observations will be continued next season, in the light of past experience.

3. Fungous Diseases on Station Farm.

The following notes include only such diseases as attacked crops grown on the station farm during the past season with sufficient violence to produce results of economic importance. Many fungi, of course, were found, whose presence was of no practical importance to the various plants on which they occurred; but a few produced striking results by their abundance and vigor. The meteorological conditions of the season were peculiarly favorable to the development of fungi.

1. The *smut* of barley and oats (*Ustilago segetum* Pers.*) attacked both of those grains on the east fields and on the experimental plats to such an extent that the "smutted" heads formed a very appreciable portion of the whole. Even were the affected heads but a small fraction of one per cent. of the whole, the loss on a large field would be sufficient to justify attempts to save it, as a little calculation will show. The parasite under consideration appears on the fruiting heads of the small grains, and, when ripe, presents only the mass of black spores characteristic of the *smuts*, which completely replaces the substance of the seed. The enclosing seed coats burst open, and the spores are carried in all directions by the wind, finding lodgement on the surrounding plants and soil. Although the smut spores ripen considerably earlier than does the grain in the sound heads, grain from a smutted field is sure to have them adhering to its surface and entangled in the tuft of hairs at its end, especially if smutted heads have been mixed with the sound ones in threshing. Unless they are present in very large numbers,

* It may be explained that the scientific name of a plant consists of three parts, the name of the *genus* or group of closely related plants to which it belongs, the name of its particular kind or *species*, and the name (in full or abbreviated) of the person or persons to whom it owes the name.

they cannot be detected by the unaided eye. These spores remain unchanged during the winter, and are ready for germination with the seed, when it is planted in the spring. Experiments have shown that the germinating tubes of the smut fungus can penetrate and infect the plants of grain only when they are very young seedlings, with very tender and easily penetrable tissues. Having once gained entrance to the interior of such a plant, however, the fungus grows with the plant, invading the new tissues as they are formed, and finally reaching its complete development by producing its reproductive bodies in the place of the destroyed reproductive bodies of its host. If the grain, with adhering smut spores, be fed to horses or cattle, the spores pass through the body and are voided unharmed. And not merely unharmed; their passage through the animal body seems to cause them to germinate more readily than before, and they produce, in the manure heap, tiny bodies which increase rapidly by a process of budding similar to that of the yeast fungi. Thus a few spores may produce, in a short time, a multitude of these tiny buds, each of which can infect a grain seedling with the smut parasite.

Since the infection of neighboring plants cannot be caused by a "smutty" plant, the problem of dealing with the present trouble is much simpler than similar problems concerning the numerous fungi which spread rapidly by summer spores. It is evident that it is useless to attempt to save a plant once attacked by smut; but the facts just stated concerning the fungus under discussion point to three lines of defence against its attacks: (1) The conditions for the germination of the seed and the growth of the seedling should be as favorable as possible, in order that the period of susceptibility to infection may be made as short as possible. To this end, well-matured seed should be sown on well-prepared and well-drained soil, in favorable "growing" weather. (2) Suitable commercial fertilizers should replace animal manures, on fields to be sown to grain. This will eliminate from the problem an important complication. (3) The seed grain should be treated, before being sown, with a preparation which will kill the adhering spores, with the least damage to the seed. The best for this purpose seems

to be a one-half per cent. solution of sulphate of copper, prepared by dissolving it in water in the proportion of one pound to twenty-five gallons. The grain should be thoroughly wet with this solution, and allowed to soak in it for from twelve to twenty-four hours. It may then be spread out for a few hours, till dry enough to be readily sown. This treatment is very efficacious and inexpensive.

2. The *spot disease* of sugar beets appeared on the leaves of that crop about the end of June, in the form of dead, dry, circular patches, from one-eighth to three-eighths of an inch in diameter. These patches are the result of the death of the leaf tissues, caused by their invasion by a fungus mycelium. While a few patches would do little harm on the large leaf of a beet, they often become so abundant, as in the present case, as to destroy a large part of the tissue of the leaves. Since, as we have seen, the leaves, being the chlorophyll-containing organs, are those on which the plant depends for its supply of organic food material, it is evident how serious for the plant must be the loss, during its time of active growth, of a large fraction of its working leaf surface. In the case under notice, the spots gradually extended and increased, until, in August, the leaves died completely from the violence of the attack. By this time, however, the roots were so well grown that they were able to put out promptly a fresh growth of leaves, which continued through the rest of the season, though themselves affected somewhat by the *spot*. Clearly, the production of new leaves must have involved the conversion, for that purpose, of a considerable amount of stored material from the root, which ought to have remained there. This loss, with that due to the diminution of active surface on both sets of leaves, must very materially reduce the amount of solid matter in the roots, and lessen their feeding value in proportion.

Two fungus forms appeared on the spots on the station beets, both of them belonging to the *Imperfect Fungi*. Up to about the 10th of July, the most abundant form was that known to botanists as *Septoria Betæ* West., while after that time the chief form, and, late in the season, apparently the only form, was that known as *Cercospora beticola* Sacc. In

view of their appearance on the same spots, and in the relations described, it is pertinent to inquire if they may not be forms of the same pleomorphic fungus. Direct proof, either for or against this hypothesis, is, however, still wanting.

No very definite directions for combating this trouble can be given, in the absence of more complete knowledge of the accompanying fungus forms than we yet have. As both *Septoria* and *Cercospora* spores quickly germinate and infect new hosts, that is, are summer spores, it is probable that spraying the crop as soon as the spots begin to appear may check its spread. It is probable that the "Eau Celeste" would give good results. Leaves badly attacked should be burned; all refuse should be cleared from the field at the end of the season, and burned; and the same crop should not be planted on the same ground or in its immediate neighborhood, the following year.

3. The *rot* of potatoes has been unusually serious on the station plots, as throughout the State, during the season just past. This disease, known as *blight* when it attacks the tops, and as *rot* when the tubers are affected, is due to a fungus of the downy mildew group, *Phytophthora infestans* deBary. Its abundance and destructiveness in 1889 have called out so many descriptions and recommendations concerning the fungus and means for checking it, that an extended account is superfluous here. The fungus spreads very rapidly by means of summer spores, but, so far as is known, does not, like most of the downy mildews, produce resting spores. Its only known mode of passing the winter is by the hibernation of its mycelium in the host tubers. Special care should be taken, then, to avoid planting "seed" potatoes which contain this hibernating mycelium, whose presence is commonly indicated by dark-brown sunken spots on the surface of the tuber, beneath which the tissues are more or less "rotted." A fuller account of this very fatal disease, by the present writer, may be found in Bulletin No. 6 of the Hatch Experiment Station of the Massachusetts Agricultural College.

The blight which appeared on the leaves of potatoes on the plot devoted to *scab* experiments, as previously men-

tioned, spread rapidly, but not with perfect regularity. When the leaves and stems were mostly killed by the fungus, the fourth day after its appearance, those on sections 1 and 14, the third row of section 6, and the second and third rows of both 7 and 13, were still fresh and comparatively unharmed. Comparison with the table given above shows that the sections which suffered least were those in which the potatoes were planted directly on manure, and the rows which were planted with the varieties designated as *white* and *black*. That some varieties are less susceptible than others to attacks of the rot, has been repeatedly shown; but why planting on manure should give protection against it, as seems here to have been the case, is not easy to see; yet there was no other difference in conditions between plots 1 and 14, on one hand, and 2–4, 9–11, and 15–16, on the other hand. Yet all the latter suffered equally and very severely. The attack was not of the most violent sort, and, even on the worst-affected plants, there was not the complete collapse into a slimy, putrescent mass, which is the result of the extreme form of the disease. Nothing now remained to be done but to harvest the potatoes as quickly as possible. Press of other farm work prevented immediate attention, but they were all harvested before the end of the month, in very good condition, so far as the *rot* was concerned. Later potatoes, on other fields, which received less prompt attention, were an almost total loss.

Notes on other fungous diseases are reserved until more complete data can be accumulated concerning them.

4. Notes on Material referred to the Department.

Some of the examinations which have been made by the department, of specimens referred to it, may be of sufficient general interest to warrant a brief discussion here.

1. *Fungus in Cellar.* — In December, 1888, a quantity of a white, flocculent substance, mixed with gravel from the cellar bottom on which it had grown, was sent in for examination. The house from whose cellar the material was taken was a tenement-house, and the white growth in question was a source of alarm to the tenants, who threatened to

leave, fearing that its appearance was an indication of the unhealthfulness of the premises.

It was evident to the unaided eye, and microscopic examination confirmed the opinion, that the white material was the sterile mycelium of some fungus. As there was no trace of spore formation, it was impossible to say to what fungus the mycelium belonged, though more probably to some member of the toadstool group.

The only conditions necessary to the development of such mycelia are the presence of spores, and of certain degrees of temperature and moisture. The latter conditions are afforded by even the best of cellars, which receive no artificial heat, and fungus spores penetrate every crevice with the air in which they float. Not only are such growths perfectly harmless in themselves, but their occasional appearance is no indication of unhealthful conditions; although their very constant or luxuriant appearance is often an accompaniment of extreme dampness. For the sake of neatness, it is best to remove them with rake or broom, and prevent their reappearance on the same surface by the free application of lime, either dry or in the form of whitewash.

A report to this effect was made in the present case, but it was afterwards learned that the tenants had already left, victims to their superstitious fears and dread of the "mysterious."

It should be remarked here that the appearance of white fungus mycelia, followed by the development, on the surface of the mass, of a rusty-brown spore layer, with the exudation of watery drops at its margin, should receive prompt attention. The fungus which answers to this description belongs to the toadstool group, and appears on woodwork or even on cellar bottoms. It produces a very rapid and destructive "dry rot" of timber, and is known in Germany as the "house fungus." It should be thoroughly destroyed, and all woodwork in its vicinity painted or well whitewashed.

2. *Black Spot of Rose Leaves.* — A disease affecting the leaves of roses growing in the Durfee plant-house of the Massachusetts Agricultural College was referred by Prof. S. T. Maynard to this department for examination and

report, in December, 1888. The leaves showed the dark, cloudy and dendritic patches, and the small, slightly raised pustules characteristic of the "black spot" of the rose; and the microscope showed the presence of an abundant mycelium in the spots, producing at certain points masses of the spores of the "black-spot" fungus, *Actinonema rosæ* Fr. The spore-bearing spots are indicated by the pustules, which are formed by the elevation of the surface layer or *epidermis* of the leaf by the developing spore masses. As the internal tissue of the leaf is invaded by the mycelium, it is gradually killed, and loses its green color; so arise the discolored spots, which give the disease its name, and which, at first small, spread radially in all directions from the point of infection. The fungus which causes this trouble is one of the imperfect fungi, and its relation to other forms remains still undetermined.

The same disease appeared abundantly on leaves of roses cultivated out of doors in the garden of a very successful amateur in Amherst, last summer.

Infected leaves should be carefully collected and destroyed, to prevent the dissemination of spores; and it is probable that spraying with some fungicide will prove efficacious in checking the disease, if done early and frequently enough. For fuller details and recommendations, reference may be had to the report of the mycologist of the United States Department of Agriculture, for 1887, p. 366, and to Bulletin No. 6 of the Hatch Experiment Station, before referred to.

3. *Nematode Disease of Cucumbers.* — A disease seriously affecting cucumbers raised under glass came to my attention in July last, through Mr. H. T. Fernald of Amherst. It manifests itself first in the yellowing of the foliage, which is followed by the death of the plant. But the real seat of trouble is in the roots, on which are formed rough, tubercle-like swellings or *galls*, in which the tissues are loose and spongy, and easily crumble. Examination showed the presence in these galls of very numerous microscopic worms and their eggs. The worms measure perhaps one-fiftieth of an inch in length, and belong to the group known as thread-worms or *nematodes*, which attack the roots of many plants with fatal results.

This nematode disease of cucumbers is known in England, and is said to have been successfully treated by watering the soil in which the diseased plants were growing, with a weak solution of permanganate of potash, which appears to be fatal to the worms, without injuring the plants. It is suggested that the sulphate of manganese would probably be as efficient as the permanganate of potash, while it is much cheaper. The writer will be glad to communicate with any-one who is troubled by this disease, and wishes to experiment in combating it.

2. — Communication by C. A. Goessmann.

The investigations concerning the effect of various modes of cultivation and of manuring on the general character and composition of fruits and garden crops will be resumed, as far as practicable, during the coming year. The circumstances which some years ago obliged me to discontinue that work as outlined in our first and second annual reports, under the heading "Chemistry in Fruit Culture," are not existing now. The late permanent assignment of suitable fields, as well as the recent erection of buildings designed with a view to offer to growing plants the necessary protection against objectionable features of climate and weather, promise to favor our plans of operation. The co-operation of our experiments in the field and in the vegetation house cannot fail to assist materially in drawing correct conclusions from our results.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers: —
   1. General introduction.
   2. Laws for the regulation of the trade in commercial fertilizers.
   3. List of licensed manufacturers for May 1, 1889, to May 1, 1890.
   4. Analyses of licensed fertilizers.
   5. Analyses of commercial fertilizers and manurial substances sent on for examination.
   6. Miscellaneous analyses.

II. Water analyses.

III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

I. Communication on Commercial Fertilizers.

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1. General Introduction.

The new duties assigned to the director of the station render it necessary to discriminate, in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers, and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition, and to such additional information as relates to the latter. The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents, has, therefore, to be discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a consideration of the particular composition of the different brands of fertilizers offered for their patronage, — a circumstance not unfrequently overlooked.

The approximate market value of the different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their

crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage, requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food — *i.e*, phosphoric acid, nitrogen and potash — which they contain. To ascertain, by this mode of valuation, the approximate market value of a fertilizer (*i.e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid, and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility and the more or less rapid diffusion of the different articles of plant food throughout the soil. The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration, at the same time, their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals. (*1889.*)

	Cents per Pound.
Nitrogen in ammoniates,	19
Nitrogen in nitrates,	17
Organic nitrogen in dry and fine-ground fish, meat and blood,	19
Organic nitrogen in cotton-seed meal and castor pomace,	15
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,	7½

Trade Values of Fertilizing Ingredients — Concluded.

	Cents per Pound.
Phosphoric acid in dry ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarse bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in form free from muriates or chlorides; ashes, etc.,	6
Potash as kainite,	4½
Potash as muriate,	4½

The organic nitrogen in superphosphates, special manures and mixed fertilizers of a high grade, is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, nineteen cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. For similar reasons, the insoluble phosphoric acid is valued in this connection at three cents; it being assumed, unless found otherwise, that it is from bone or similar source, and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but two cents per pound.

The above trade values are the figures at which, in the six months preceding March, 1889, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials, which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1, plus twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,	Dry ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect, at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary character of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guaranty of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale in our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing circumstances. Requests for analyses of substances, as fodder articles, fertilizers, etc., coming through officers of agricultural societies and farmers' clubs within the State, will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without charge for the services rendered. Applications of private parties for analyses of

substances, free of charge, will receive a careful consideration, whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent on to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

2. *Laws for the Regulation of the Trade in Commercial Fertilizers.*

[CHAP. 296.]

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

Be it enacted, etc., as follows:

SECTION 1. Every lot or parcel of commercial fertilizers or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial pur-

poses, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a

number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

Instructions issued at the Beginning of the Season, to Dealers in Commercial Fertilizers.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide, guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers, but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the 1st of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers, are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the director of the Massachusetts State Agricultural Experiment Station.

3. *List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in This State during the Past Year, and the Brands Licensed by Each.*

Forest City Wood Ash Company, London, Ontario, Canada: —
Canada Unleached Wood Ashes.

Bowker Fertilizer Company, Boston, Mass: —
Stockbridge Manures.
Bowker's Hill and Drill Phosphate
Bowker's Ammoniated Bone Fertilizer.
Bowker's Lawn and Garden Fertilizer.
Bowker's Fish and Potash.
Bowker's Dry Ground Fish.
Gloucester Fish and Potash.
Fine-ground Bone.
Plain Superphosphate.
Kainite.
Nitrate of Soda.
Dried Blood.
Dissolved Bone-black.
Muriate of Potash.
Sulphate of Potash.

National Fertilizer Company, Bridgeport, Conn.: —
Chittenden's Complete Fertilizer
Chittenden's Fish and Potash.
Chittenden's Phosphate.

Hargrave Manufacturing Company, Fall River, Mass.: —
Hargrave's Bone.

William E. Fyfe & Co., Clinton, Mass.: —
Canada Unleached Wood Ashes.

Edmund Hersey, Hingham, Mass.: —
Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Read Fertilizer Company, Syracuse, N. Y.: —
- Farmer's Brand.
- Lion Brand.
- High-grade Farmer's Friend Special.
- Sampson or Lion Special.

E. Frank Coe, New York, N. Y.: —
- E. Frank Coe's Gold Brand Excelsior Guano.
- Fish and Potash.
- Potato Fertilizer.
- Alkaline Bone.
- E. Frank Coe's High-grade Ammoniated Bone Superphosphate.

Cumberland Bone Company, Portland, Me.: —
- Seeding-down Fertilizer.
- Cumberland Superphosphate.

Williams & Clark Company, New York, N. Y.: —
- Americus Ammoniated Bone Superphosphate.
- Potato Phosphate.

Great Eastern Fertilizer Company, Rutland, Vt.: —
- Great Eastern General for Grain and Grass.
- Great Eastern Vegetable, Vine and Tobacco Fertilizer.
- Great Eastern General Oats, Buckwheat and Seeding-down Phosphate.

Joseph Church & Co , Tiverton, R. I.: —
- Fish and Potash.
- Church's Special.
- Church's Standard.
- Dried and Ground Fish.

Thompson & Edwards Fertilizer Company, Chicago, Ill.: —
- World of Good Tobacco Guano.

J. A. Tucker & Co., Boston, Mass.: —
- Original Bay State Bone Superphosphate.
- Imperial Bone Superphosphate.

Edw. F. Jennison, Lancaster, Mass.: —
- Jennison's Complete Animal Fertilizer.

Orient Guano Manufacturing Company, New York, N. Y.: —
- Suffolk County.
- Orient Complete Manures.
- Fish and Potash.

Davidge Fertilizer Company, New York, N. Y.: —
- Davidge's Potato Manure.
- Davidge's Vegetator.
- Davidge's Special Favorite.

Lister's Agricultural Chemical Works, Newark, N. J.: —
- Lister's Standard Superphosphate of Lime.
- Lister's Ammoniated Dissolved Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

J. M. Butman, Lowell, Mass.: —
Lowell Bone Fertilizer.

Adams & Thomas, Springfield, Mass.: —
Adams Market Bone Fertilizer.

Whittemore Brothers, Wayland, Mass.: —
Whittemore's Complete Manure.

Mayo & Hix, Boston, Mass.: —
Mayo Superphosphate.

John C. Dow & Co., Boston, Mass.: —
Dow's Ground Bone Fertilizer.

J. E. Soper & Co, Boston, Mass.: —
Cotton-seed Hull Ashes.

F. C. Sturtevant, Hartford, Conn.: —
Tobacco Stems.

E. H. Smith, Northborough, Mass.: —
Smith's Steamed Bone.

A. L. Ames, Peabody, Mass.: —
Ames' Bone Fertilizer.

The Mapes Formula and Peruvian Guano Company, New York, N. Y.: —
The Mapes Bone Manures.
Peruvian Guanos.
The Mapes Superphosphate.
The Mapes Special Corn Manures.

C. A. Bartlett, Worcester, Mass.: —
C. A. Bartlett's Pure Ground Bone.
Animal Fertilizer.

Bradley Fertilizer Company, Boston, Mass.: —
Bradley's XL Phosphate.
B. D. Sea-fowl Guano.
Coe's Superphosphate.
Fish and Potash.
Pure Fine-ground Bone.
Bradley's Complete Manures: —
For Potatoes and Vegetables.
For Corn and Grain.
For Top-dressing Grass and Grain.
Bradley's Grass Manure for Top-dressing.
Bradley's Potato Manure.
Nitrate of Soda.
Sulphate of Ammonia.
Muriate of Potash.
Dissolved Bone-black.

Cleveland Dryer Company, Cleveland, Ohio: —
Cleveland Potato Phosphate.
Cleveland Superphosphate.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

American Manufacturing Company, Boston, Mass.: —
The Allen Fertilizer.

G. E. Holmes, New Worcester, Mass.: —
Fine-ground Bone.

Wm. J. Brightman & Co., Tiverton, R. I.: —
Fish and Potash.
Superphosphate.
Dry Ground Fish.

S. Winter, Brockton, Mass.: —
S. Winter's Pure Ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y.: —
New Rival Ammoniated Superphosphate.
Buffalo Superphosphate, No. 2.
Special Potato Manure.
Pure Ground Bone.
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Queen City Phosphate.
Vegetable Bone Superphosphate.
Ammoniated Wheat and Corn Phosphate.

Standard Fertilizer Company, Boston, Mass.: —
Standard Superphosphate.
Breck's Lawn and Garden Dressing.

Munroe, Judson & Stroup, Oswego, N. Y.: —
Unleached Canada Wood Ashes.

Benj. Randall, Boston, Mass.: —
Randall's Market-garden Fertilizer.
Randall's Combined Bone.

The Le Page Company, Boston, Mass.: —
The Red Star Brand 203 Fertilizer.
The Red Star Brand Special Potato Fertilizer.

Pacific Guano Company, Boston, Mass.: —
Soluble Pacific Guano.
Fish and Potash.
Special Potato Manure.

The Quinnipiac Company, New London, Conn.: —
Quinnipiac Phosphate.
Quinnipiac Potato Manure.
Quinnipiac Dry Ground Fish.
Quinnipiac Fish and Potash.

A. Lee & Co., Boston, Mass.: —
Lawrence Fertilizer.
Ground Bone.

3. *List of Dealers who have secured Certificates, etc.* — Concluded.

H. J. Baker & Bros., New York, N. Y. : —
- A. A. Ammoniated Superphosphate.
- Pelican Bone Fertilizer.
- Potato Manure.

John G. Jefferds, Worcester, Mass. : —
- Jefferds' Animal Fertilizer.
- Jefferds' Fine-ground Bone.

N. Ward Company, Boston, Mass. : —
- N. Ward Company's High-grade Animal Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I. : —
- Darling's Animal Fertilizer.
- Extra Bone Phosphate.
- Darling's Potato and Root Crop Manure.
- Darling's Pure Bone.
- Muriate of Potash.
- Sulphate of Potash.

Butler, Breed & Co , Boston, Mass. : —
- Economic No. 1 Fertilizer for Grass.
- Economic No. 2 Fertilizer for Pasture.
- Economic No. 3 Fertilizer for Corn.
- Economic No. 4 Fertilizer for Potatoes.
- Economic No. 7 Fertilizer for Garden.

Stearns' Fertilizer Company, New York, N. Y. : —
- Stearns' Ammoniated Bone Superphosphate.
- Stearns' American Guano.

Thos. Hersom & Co., New Bedford, Mass. : —
- Pure Fine-ground Bone.

H. L. Phelps, Southampton, Mass. : —
- H. L. Phelps' Complete Manure.

Prentiss, Brooks & Co., Holyoke, Mass. : —
- Dry Fish.
- Dissolved Bone-black.
- Muriate of Potash.
- Nitrate of Soda.

4. Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
7	High-grade Farmer's Friend Special,	Read Fertilizer Company, New York,	Pittsfield.
8	Farmer's Friend,	Read Fertilizer Company, New York,	Pittsfield.
9	Lion Brand,	Read Fertilizer Company, New York,	Pittsfield.
11	Quinnipiac Phosphate,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
12	Quinnipiac Fish and Potash,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
13	Quinnipiac Potato Manure,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
17	Vegetator,	Davidge Fertilizer Company, New York,	Amherst.
18	Bowker's Potato Grower,	Bowker Fertilizer Company, Boston,	Sunderland.
23	Chittenden's Universal Phosphate,	National Fertilizer Company, Bridgeport, Conn.,	Sunderland.
24	Chittenden's Tobacco Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Sunderland.
33	Mapes' Potato Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
	Bones and Tankage.		
2	Hargrave's Bone,	Hargrave Manufacturing Company, Fall River, Mass.,	Fall River.
3	Steamed Bone,	Edmund Hersey, Hingham, Mass.,	Hingham.
4	Steamed Bone,	Edward H. Smith, Northborough, Mass.,	Amherst.
38	Holmes' Steamed Bone,	G. E. Holmes, Worcester, Mass.,	Worcester.
43	Bartlett's Steamed Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen in One Hundred Pounds. Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide in One Hundred Pounds. Guaranteed.
	Compound Fertilizers.												
7	High-grade Farmer's Friend Special,	14.20	4.24	3.3—4.5	3.38	2.02	2.38	7.78	6—7	5.40	5—6	9.84	10—12
8	Farmer's Friend,	14.10	2.72	2.06—2.88	7.24	2.33	2.81	12.38	11—13	9.57	9—11	2.32	-*
9	Lion Brand,	12.54	1.08	.82—1.65	6.40	2.43	2.07	10.90	10—12	8.83	8—10	3.66	-*
11	Quinnipiac Phosphate,	18.49	2.70	2.5—3.25	3.74	6.75	2.46	12.95	10—16	10.49	9—13	2.05	2—3*
12	Quinnipiac Fish and Potash,	18.28	4.28	3.25—4.25	0.48	5.82	4.03	10.33	5—7	6.30	3—5	4.48	3—5*
13	Quinnipiac Potato Manure,	16.67	2.96	2.5—3.25	3.33	3.38	1.43	8.14	6—12	6.71	5—9	5.34	5—6*
17	Vegetator,	6.75	3.20	3.3—4.12	4.91	0.51	1.51	6.93	-	5.42	5—7	4.08	-*
18	Bowker's Tobacco Grower,	6.05	3.36	3.25—4.25	6.94	1.38	3.55	11.87	-	8.32	8—10	5.52	4—5
23	Chittenden's Universal Phosphate,	13.12	2.86	2.—2.9	6.24	3.72	2.53	12.49	11—12	9.96	9—11	2.86	2—3
24	Chittenden's Tobacco Fertilizer,	9.44	3.28	3.3—4.9	7.04	2.16	2.89	12.09	8—10	9.20	6—8	5.56	-*
33	Mapes' Potato Manure,	6.45	3.72	3.71—4.12	6.27	4.13	2.24	12.64	8—10	10.40	6—8	6.56	6—8*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analyses. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones and Tankage.														
2	Hargrave's Bone,	6.61	3.02	-	0.28	10.01	15.67	25.96	-	10.29	-	-	-	-	-
3	Steamed Bone,	2.65	3.18	-	0.31	8.39	10.87	19.57	-	8.70	-	34.41	21.03	21.96	22.60
4	Steamed Bone,	5.46	4.48	4.—4.5	0.38	8.72	12.78	21.98	21.5—22.5	9.10	6.6—9.1	39.45	36.35	22.95	1.25
38	Holmes' Steamed Bone,	10.87	3.27	2.5—3.5	0.32	11.37	10.56	22.25	22—24	11.69	-	25.79	47.72	26.49	-
43	Bartlett's Steamed Bone,	5.75	3.15	2.39	0.42	13.03	12.79	26.24	27.35	13.45	7.59	39.87	39.98	20.15	-

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
5	Lowell Bone Fertilizer,	J. M. Butman, Lowell, Mass.,	Lowell.
10	Sampson Brand or Lion Special,	Read Fertilizer Company, New York,	Pittsfield.
15	Special Favorite,	Davidge Fertilizer Company, New York,	Amherst.
19	Stockbridge's Tobacco Manure,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
25	Cumberland Bone Superphosphate,	Cumberland Bone Company, Portland, Me.,	Sunderland.
32	Mapes' Complete Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
39	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
42	Jefferds' Animal Fertilizer with Potash,	J. G. Jefferds, Worcester, Mass.,	Worcester.
44	Americus Brand Ammoniated Superphosphate,	Williams & Clark Company, New York,	Worcester.
54	Church's Fish and Potash,	Joseph Church & Co., Tiverton, R.I.,	Springfield.
55	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
57	Dry Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
58	Bradley's Fish and Potash, "A" Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
68	Original Bay State Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Chelsea.
69	Imperial Bone Superphosphate,	J. A. Tucker & Co , Boston, Mass.,	Chelsea.
83	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Ipswich.
84	Dow's Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Ipswich.
88	Darling's Pure Dissolved Bone,	Darling Fertilizer Company, Pawtucket, R. I.,	Ipswich.
111	Extra Bone Phosphate,	Darling Fertilizer Company, Pawtucket, R. I.,	Taunton.
30	Cotton-hull Ashes,	Quinnipiac Company, New London, Conn.,	Northampton.
29	Muriate of Potash,	Quinnipiac Company, New London, Conn ,	Northampton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
5	Lowell Bone Fertilizer,	7.28	2.35	2.0—2.5	5.41	8.12	2.01	15.54	14.5—17.5	13.53	12.5—14.5	3.63	3—3.5
10	Sampson Brand or Lion Special,	14.04	2.76	2.47—3.30	6.14	2.58	2.51	11.23	10—12	8.72	8—10	3.96	–*
15	Special Favorite,	10.32	1.32	1.24—2.06	7.84	1.53	2.28	11.65	12—14	9.37	10—12	1.45	1.5—2.5
19	Stockbridge's Potato Manure,	4.87	5.62	5.75—6.75	3.40	1.84	2.78	8.02	5—7	5.24	4—5	10.26	10—12*
25	Cumberland Bone Superphosphate,	12.44	2.32	2—3	6.01	6.40	4.04	16.48	13—14	12.44	9—13	2.72	2—3
32	Mapes' Complete Manure,	10.72	3.12	3.30—4.12	3.89	3.24	3.97	11.10	10—12	7.13	–	4.17	4—5
39	Bradley's XL Superphosphate of Lime,	14.52	3.52	2.50—3.25	8.09	2.56	1.89	12.54	11—14	10.65	9—11	2.24	2—3
42	Jefferds' Animal Fertilizer with Potash,	3.88	3.12	4.12—5.77	0.28	9.63	11.33	21.24	14—16	9.91	–	4.83	5—7
44	Americus Brand Ammoniated Superphosphate,	16.59	2.37	2—3	8.92	1.73	0.28	10.93	11—16	10.65	10—12	1.82	2—3*
54	Church's Fish and Potash,	18.82	3.74	3.3—4.12	2.02	2.62	1.12	5.76	5—6	4.64	–	4.18	3—5
55	Adams' Market Bone Fertilizer,	11.66	3.08	2.5—3.5	1.92	5.57	3.10	10.59	8—10	7.49	6—8	5.60	3—5
57	Dry Fish Guano,	9.22	9.00	8.24—9.89	0.46	4.45	2.48	7.39	6—8	4.91	–	–	–
58	Bradley's Fish and Potash, "A" Brand,	16.46	3.25	2—3	2.57	1.98	1.45	6.00	–	4.55	4—6	4.99	4—6
68	Original Bay State Bone Superphosphate,	16.91	2.77	2.47—2.88	5.97	1.67	2.26	10.90	10—12	7.64	9—9.5	2.27	2—3
69	Imperial Bone Superphosphate,	20.10	2.38	2.06—2.47	5.53	2.50	2.75	10.78	9—10	8.03	8—9	1.85	2.5—3
83	Ames' Bone Fertilizer,	11.29	2.66	1.65—2.47	6.08	3.29	0.32	9.69	8—12	9.37	8—10	1.39	1—3
84	Dow's Nitrogenous Superphosphate,	11.16	2.65	2.06—2.88	3.34	7.11	2.37	12.82	–	10.45	8—10	3.78	3—4
88	Darling's Pure Dissolved Bone,	4.67	2.01	2.06—2.88	7.04	8.95	2.56	18.55	16—18	15.99	11—16	–	–
111	Extra Bone Phosphate,	10.81	2.60	2.47—3.30	5.76	2.91	2.33	11.00	10—12	8.67	7—9	3.28	3—5
30	Cotton-hull Ashes,	8.11	–	–	–	–	–	9.62	–	–	–	22.80	
29	Muriate of Potash,	2.05	–	–	–	–	–	–	–	–	–	49.67	–†

* Sulphate of potash the source of potash. † Guaranteed eighty per cent. muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
16	Potato Fertilizer,	Davidge Fertilizer Company, New York,	Amherst.
20	Animal Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
49	Ammoniated Bone Superphosphate, Americus Brand,	Williams & Clark Co., New York,	Springfield.
52	A. A. Ammoniated Bone Superphosphate,	H. J. Baker & Bro., New York,	Springfield.
108	A. A. Ammoniated Bone Superphosphate,	H. J. Baker & Bro., New York,	New Bedford.
53	Potato Manure,	H. J. Baker & Bro., New York.	Springfield.
59	Chittenden's Complete Fertilizer for Grass,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
61	Mapes' Complete Manure for Light and Sandy Soils,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
65	Red Brand, Special Fertilizer for Potatoes, Cabbage and Pease,	Le Page Company, Boston, Mass.,	Boston.
76	Randall Market Garden Fertilizer,	Benj. Randall, Boston, Mass ,	Boston.
98	Crocker's New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
102	Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
110	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R I.,	Taunton.
124	Jennison's Animal Fertilizer,	Edward F. Jennison, Lancaster, Mass.,	South Lincoln.
129	Lister's Ammoniated Dissolved Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Turner's Falls.
132	Sea-fowl Guano,	Bradley Fertilizer Company, Boston, Mass.,	Turner's Falls.
134	Orient Complete Manure,	Orient Guano Company, Orient, L. I.,	Sheffield.
135	Great Eastern Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
137	Potato Fertilizer,	E. Frank Coe, New York,	Westfield.
	Bones and Tankage.		
123	Hersom's Tankage,	Thomas Hersom & Co., New Bedford,	New Bedford.
95	Bowker's Fine-ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
118	Hargrave's Fine-ground Bone,	Hargrave Manufacturing Company, Fall River,	Fall River.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
16	Potato Fertilizer,	12.37	3.08	2.88—3.71	8.10	1.06	1.32	10.18	10—12	9.16	9.5—11	3.02	–*
20	Animal Fertilizer,	9.93	2.97	–	6.14	1.96	6.40	14.50	10—12	8.10	6—8	3.34	–†
49	Ammon. Bone Superphos., Americus Brand,	16.86	2.66	2—3	9.03	1.65	0.23	10.91	10—16	10.68	10—12	1.98	2—3
52, 108	A. A. Ammoniated Superphosphate,	13.32	3.42	2.47—3.3	10.09	1.36	1.13	12.58	–	11.45	10—12	2.58	2—3
53	Potato Manure,	9.89	4.17	3.30	5.95	1.34	0.81	8.10	–	7.29	5.75	9.33	10.
59	Chittenden's Complete Fertilizer for Grass,	12.86	3.62	4.12—4.94	5.88	3.43	2.91	12.22	6—8	9.31	4—6	5.56	5—7
61	Mapes' Com. Manure for Light and Sandy Soil,	11.40	5.66	4.94—6.59	5.50	1.19	2.30	8.99	8—10	6.69	8.	6.46	6—8
65	Red Star Brand, Spec. Fert. for Potatoes, etc,	15.37	3.01	3—4	4.16	2.35	3.26	9.77	8—10	6.51	6—8	3.34	–*
76	Randall's Market Garden Fertilizer,	11.22	3.36	2.88—3.71	5.28	2.51	1.66	9.45	–	7.79	8.5—11	3.68	4—5
98	Crocker's New Rival Ammo. Superphosphate,	15.57	1.43	1.23—2.06	7.94	1.72	1.33	11.05	–	9.66	10—12	2.08	–*
102	Lawrence Fertilizer,	15.37	1.78	2.06—2.88	9.86	1.34	0.95	12.15	10—12	11.20	–	1.61	2—3
110	Potato and Root Crop Manure,	12.57	3.12	2.88—4.12	4.81	1.91	3.81	10.53	10—12	6.72	–	8.96	7—9
124	Jennison's Animal Fertilizer,	3.59	5.40	3—4	0.08	5.93	6.78	12.79	11—12.5	6.01	6—8	8.94	7—8
129	Lister's Ammoniated Dissolved Bone,	14.84	2.09	1.65—2.06	7.14	2.07	3.39	12.60	10—13	9.21	8—10	1.67	1—2
132	Sea-fowl Guano,	13.61	2.60	2.06—2.68	7.38	2.84	3.19	13.41	11—14	10.22	9—11	2.42	2—3
134	Orient Complete Manure,	13.84	2.20	1.65—2.47	8.71	0.18	1.41	10.30	–	8.89	8—12	2.28	2—4
135	Great Eastern Tobacco Fertilizer,	14.12	2.31	1.65—2.47	7.54	1.58	1.56	10.68	–	9.12	8—12	4.51	6—8
137	Potato Fertilizer,	13.21	2.06	2—2.5	7.48	1.53	1.66	10.67	–	9.01	8—11	5.52	–*
	Bones and Tankage.												
123	Hersom's Tankage,	3.42	4.24	2.08	–	6.73	12.79	19.52	29.42	6.73	13.62		
95	Bowker's Fine-ground Bone,	9.15	3.48	2.5—3.25	1.66	7.27	14.66	23.59	18—22	8.93	–		
118	Hargrave's Fine-ground Bone,	10.28	3.25	3.93	.37	12.01	13.19	25.57	18.80	12.38	4.12		

Mechanical Analyses.

Laboratory Number.	Name of Brand.	Fine.	Fine Medium.	Medium.	Coarse Medium.
123	Hersom's Tankage,	–	–	–	–
95	Bowker's Fine-ground Bone,	50.80	28.77	11.18	9.25
118	Hargrave's Fine-ground Bone,	43.43	23.01	14.20	19.36

* Sulphate of potash the source of potash.

† Guaranteed as muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
1	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Peabody.
28	Stockbridge's Manure for Top Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
46	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Fitchburg.
71	Standard Superphosphate,	Standard Fertilizer Company, Duxbury, Mass ,	Boston.
78	Economic No. 1, for Grass,	Economic Fertilizer Company, Boston, Mass.,	Boston.
105	Church's Dry Ground Fish,	Joseph Church & Co., Tiverton, R. I.,	New Bedford.
127	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Worcester.
144	Cumberland Seeding-down Fertilizer,	Cumberland Bone Company, Portland, Me.,	Dighton.
145	The Allen Fertilizer,	The American Manufacturing Company, Boston, Mass.,	Woburn.
146	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Waltham.
147	Davidge's Potato Manure,	Davidge Fertilizer Company, New York,	Belchertown.
148	Special Favorite,	Davidge Fertilizer Company, New York,	Belchertown.
14	Sulphate of Potash,	Quinnipiac Company, Agents, New London, Conn.,	North Amherst.
	Bones.		
41	Jefferds' Steamed Bone,	J. G. Jefferds, Worcester, Mass.,	Worcester.
73	Standard Pure Ground Bone,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
87	Darling's Pure Ground Bone,	Darling Fertilizer Company, Pawtucket, R. I.,	Ipswich.
103	Lawrence Bone Meal,	Lee & Co., Lawrence, Mass.,	Lawrence.
143	S. Winter's Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
1	Ames' Bone Fertilizer,	14.05	2.88	1.65—2.47	6.81	2.04	1.51	10.36	8—12	8.85	8—10	2.10	1—3
28	Stockbridge's Manure for Top Dressing,	11.93	3.82	5—6	5.35	5.10	0.24	10.69	6—7	10.45	3—4	6.19	5—6
46	Chittenden's Ammon. Bone Superphosphate,	12.17	2.56	1.65—2.47	8.93	0.80	3.83	13.56	9—11	9.73	7—9	2.63	2—4
71	Standard Superphosphate,	19.22	2.86	2.5 —3.5	4.51	3.66	2.17	10.34	11—14	8.17	9—13	3.13	3—4
78	Economic No. 1, for Grass,	11.61	1.36	1—2	–	0.45	4.63	5.08	2—4	0.45	–	0.36	–
105	Church's Dry Ground Fish,	11.81	9.12	–	0.59	5.64	2.34	8.57	–	6.23	–	–	–
127	Cumberland Superphosphate,	14.17	2.60	2—3	6.88	4.43	4.48	15.79	8—14	11.31	6—10	2.56	2—3
144	Cumberland Seeding down Fertilizer,	18.50	2.12	1.65	2.97	5.15	11.26	19.38	18—20	8.12	5—9	0.98	1
145	The Allen Fertilizer,	16.80	2.56	2.06—2.47	4.66	1.84	2.97	9.47	6—8	6.50	5—8	4.36	4—6
146	Mayo's Superphosphate,	18.80	2.88	2.5—3.	6.50	3.05	0.84	10.39	11.5—13.5	9.55	10.5—11.5	3.16	3—4
147	Davidge's Potato Manure,	20.43	3.88	2.47—3.71	7.45	3.27	1.43	12.15	–	10.72	9.5—11	3.89	4—6
148	Special Favorite,	9.42	1.56	1.24—2.06	7.06	2.82	2.25	12.13	12—14	9.88	10—12	1.61	1.5—2.5
14	Sulphate of Potash,	1.58	–	–	–	–	–	–	–	–	–	21.92	–

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analyses. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
41	Jefferds' Steamed Bone,	1.50	3.28	2.47—3.30	0.46	7.60	21.75	29.81	27—30	8.06	–	57.88	31.32	10.80	–
73	Standard Pure Ground Bone,	5.60	1.36	–	0.23	7.97	19.56	27.76	–	8.20	–	42.92	23.54	12.65	10.89
87	Darling's Pure Ground Bone,	2.07	3.80	3.30	0.67	8.36	15.10	24.13	24 - 26	9.03	–	50.65	31.02	18.33	–
103	Lawrence Bone Meal,	15.49	2.12	–	0.20	4.40	16.35	20.95	–	4.60	–	41.69	29.49	15.92	12.90
143	S. Winter's Pure Ground Bone,	7.93	3.28	4.20	0.33	12.93	11.58	24.84	23.66	13.26	12.85	55.85	23.59	10.19	10.37

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
21	Stockbridge's Vegetable and Potato Manure,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
22	Ammoniated Bone Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
31	Dry Ground Fish,	Quinnipiac Company, New London, Conn.,	Northampton.
34	Mapes' Complete Manure, "A" Brand,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
45	Potato Phosphate,	Williams & Clark Company, New York,	Worcester.
50	Potato Phosphate,	Williams & Clark Company, New York,	Springfield.
51	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
56	Bradley's Fish and Potash, Anchor Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
64	203 Fertilizer for General Crops,	Le Page Company, Boston, Mass.,	Boston.
70	Breck's Lawn and Garden Dressing,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
77	Randall's Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
86	Cleveland Superphosphate,	Cleveland Dryer Company, Cleveland, Ohio,	Ipswich.
92	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
97	Crocker's Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
99	Crocker's Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
104	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
114	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Fall River.
115	Brightman's Dry Ground Menhaden Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
116	Brightman's Ammoniated Bone Supherphosphate,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
119	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Hatfield.
125	Americo Guano, the Standard Potato Manure,	Stearns Fertilizer Company, New York,	Worcester.
133	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York,	No. Adams.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Stockbridge's Vegetable and Potato Manure,	17.58	3.32	3.25—4.25	6.97	1.52	2.10	10.59	8—10	8.49	7—8	5.34	5—6
22	Ammoniated Bone Fertilizer,	11.70	2.12	2.00—3.00	7.43	2.80	3.38	13.61	10—12	10.23	8—10	1.71	2—3
31	Dry Ground Fish,	10.86	7.76	7.5—10.0	1.10	2.97	3.38	7.45	7—10	4.07	4—6	–	–
34	Mapes' Complete Manure, "A" Brand,	10.96	2.75	2.47—3.30	5.16	1.40	6.19	12.75	–	6.56	10—12	3.33	2.5—3.5
45 } 50 }	Potato Phosphate,	17.35	2.11	2.0—3.0	6.15	1.33	0.37	7.85	8—10	7.48	7—10	7.42	–*
51	Bradley's Potato Manure,	12.87	2.73	2.5—3.5	5.85	2.52	2.14	10.51	8—11	8.37	6—8	5.76	5—6
56	Bradley's Fish and Potash, Anchor Brand,	10.33	3.60	3.25—4.25	2.70	1.31	1.71	5.72	5	4.01	–	3.97	3
64	203 Fertilizer for General Crops,	13.73	2.59	3—4	3.03	2.83	3.53	9.39	10—12	5.86	8—10	5.40	3—4
70	Breck's Lawn and Garden Dressing,	7.40	4.80	4.12—4.94	5.17	1.41	1.97	8.55	–	6.58	8—9	5.10	4—6
77	Randall's Bone and Potash,	10.88	2.81	1.6—2.5	7.96	3.77	1.86	13.59	13—16	11.73	5—7	3.90	2
86	Cleveland Superphosphate,	12.40	2.72	2.05—2.85	1.60	9.47	1.47	12.47	11—14	11.07	9—11	2.16	2—3
92	Bowker's Hill and Drill Phosphate,	11.27	2.54	2.5—3.25	7.77	1.53	4.84	14.14	11—14	9.30	10—12	1.83	2—3
97	Crocker's Vegetable Bone Superphosphate,	9.91	4.60	5—6	3.43	2.49	2.49	8.41	7—10	5.92	6—8	7.15	6—8
99	Crocker's Ammoniated Wheat and Corn Phosphate,	12.43	2.66	2—3	8.54	3.10	0.80	12.44	11—15	11.64	10—13	4.44	1.75—2.93
104	Lowell Bone Fertilizer,	5.40	2.96	2—2.5	4.91	6.94	2.17	14.02	14.5—17.5	11.85	12.5—14.5	3.21	3—3.5
114	Soluble Pacific Guano,	12.16	3.44	2.25—3	7.29	2.79	1.41	11.49	10.5—16.0	10.08	8.5—12	3.95	2—3.5
115	Brightman's Dry Gr'nd Menhaden Fish Guano,	9.49	9.96	8.24—9.89	0.18	4.35	4.43	8.96	–	4.53	–	–	–
116	Brightman's Ammoniated Bone Superphosp'te,	11.24	3.16	2.47—4.12	4.73	1.02	4.48	10.23	8.25—10	5.75	8—10	4.14	3—5
119	Darling's Animal Fertilizer,	15.33	3.46	3.30—4.94	4.19	3.07	2.94	10.20	10—12	7.26	–	4.41	4—6
125	Americo Guano, the Standard Potato Manure,	10.55	4.29	4.12—5.77	1.27	8.04	3.66	13.07	8—12	9.31	–	8.60	6—8
133	High-grade Ammoniated Bone Superphosphate,	12.10	2.53	2—2.5	7.98	2.39	2.05	12.42	11—13	10.37	9—12	2.48	–*

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
27	Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
35	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
47	Chittenden's Complete Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Fitchburg.
48	Flamingo Guano,	Liebig & Gibbons, Baltimore, Md.,	Fitchburg.
63	Mapes' Tobacco Manure, Conn. Brand,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
66	Red Star Brand Special Fertilizer for Onions and Tobacco,	LePage Company, Boston, Mass ,	Boston.
67	Red Star Brand, The Perfect Lawn Dressing,	LePage Company, Boston, Mass.,	Boston.
72	Breck's Top Dressing,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
81	Economic No. 4, for Potatoes,	Economic Fertilizer Company, Boston, Mass.,	Boston.
85	Cleveland Potato Phosphate,	Cleveland Dryer Company, Cleveland, O.,	Ipswich.
91	Stockbridge's Manure for Seeding-down,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
96	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Haverhill.
100	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
101	Crocker's Ammoniated Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
113	Pacific Guano Company's Special Potato Manure,	Glidden & Curtis, Boston. Mass.,	Plymouth.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
120	World of Good Potato Grower,	Thompson & Edwards Fertilizer Company, Chicago, Ill.,	Hatfield.
126	Stearns' High-grade Ammoniated Bone Superphosphate,	Stearns Fertilizer Company, New York,	Worcester.
136	Great Eastern Grain and Grass Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
138	H. L. Phelps' Phosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
139	H. L. Phelps' Potato Manure,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
140	H. L. Phelps' Complete Manure for Corn and Grass,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
27	Lawn and Garden Dressing,	11.17	3.28	3 30—4.12	9 92	1.66	2.69	14.27	–	11.58	5—6	3.60	3—4
35	Mapes' Corn Manure,	12.73	4.12	3.71—4.12	5.12	3.81	3.20	12 13	10—12	8.93	–	6.29	6—7
47	Chittenden's Complete Fertilizer,	12.01	2.98	3.30—4.12	4.10	6.56	3.29	13.95	8—10	10.66	6—8	5.11	6—8
48	Flamingo Guano,	12 35	0.80	.62—1.03	0	13 25	6.27	19.52	13—19	13.25	10—14	0.70	.25—.75
63	Mapes' Tobacco Manure, Conn. Brand,	4.52	4 48	4.74	4.67	3.65	4 22	12.54	7.75	8.32	–	5.89	7.75
66	Red Star Brand, Special Fertilizer for Onions and Tobacco,	15.46	3.32	2.47—3.30	3.71	2.46	4.13	10.33	6—8	6.20	–	4.02	–*
67	Red Star Brand, The Perfect Lawn Dressing,	6.82	3.88	4—5	6.15	1 20	3 15	10.80	10—12	7.65	8—10	4.12	4—5
72	Breck's Top Dressing,	8.40	5.96	5 77—6 59	4.80	2.04	0.26	7.10	6—8	6.84	5—6	2.60	2.5—3.5
81	Economic No. 4, for Potatoes,	11.74	0.93	.25— .75	0	0	6.41	6.41	2—4.5	0	–	Trace.	–
85	Cleveland Potato Phosphate,	8.15	4.36	2.06—2.88	6 73	2.47	3.53	12 73	10—13	9.20	8—10	3.26	3.25—4.25
91	Stockbridge's Manure for Seeding-down,	10.93	2.81	2.47—3.30	5.68	2.21	5.98	13.87	12—14	7.89	6—8	2.94	3—4
96	Bradley's XL Superphosphate of Lime,	15.82	2.74	2 50—3.25	8.82	1.62	1.90	12.34	11—14	10.44	9—11	1.86	2—3
100	Crocker's Potato, Hop and Tobacco Phosphate,	13.50	3.23	2—3	8 70	1.72	0 74	11.16	9—14	10.42	8—12	3.46	3.5—4 5
101	Crocker's Ammoniated Bone,	12.10	3.96	2.88—3.71	6.74	2.87	0.77	10.38	11—14	9 61	10—12	1.27	–*
113	Pacific Guano Co.'s Special Potato Manure,	13.22	3.66	3.30—4.12	5 53	2 40	1.82	9.75	8—12	7.93	5—8	5 57	5.5—7
117	Brightman's Fish and Potash,	26.80	3.88	2.47- 4.12	0 80	7.47	2 89	11.16	–	8.27	–	2.67	2—3
120	World of Good Potato Grower,	8 44	2.14	2.47—3 30	3 04	5.44	5.24	13.72	–	8.48	6—8	3.06	–*
126	Stearns' High-grade Am. Bone Superphosphate,	12.50	2.68	2.26—2 88	2.81	3.10	6.26	12.20	10.5—14	5.94	8.5—11	3.12	3—4
136	Great Eastern Grain and Grass Fertilizer,	19.47	2.56	2 88—3.71	6.52	1.73	3.20	11.45	9—15	8.25	8—12	2.67	2—4
138	H. L. Phelps' Phosphate,	13.35	2.92	2.47—3.30	12 72	0.24	0.24	13.20	8—10	12.96	–	3.71	3—4
139	H. L. Phelps' Potato Manure,	8.59	4.13	4 12—4.94	5.45	3.83	1 63	10.91	8—10	9.28	5—7	9 45	8—10
140	H.L.Phelps' Complete Manure, Corn and Grass,	8.12	4.12	4.12—4.94	5.69	2.72	1.25	9.66	8—10	8.41	8—10	9.86	7—8

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
36	Stockbridge's Manure for Onions,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
40	Lawn Fertilizer, Tobacco and Sulphur,	F. C. Sturtevant, Hartford, Conn.,	Worcester.
60	Chittenden's Complete Fertilizer for Potatoes,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
74	Peruvian Guano,	Mapes Formula and Peruvian Guano Company, New York,	Boston.
75	Animal Fertilizer for Lawn and Garden,	Darling Fertilizer Company, Pawtucket, R. I.,	Boston.
80	Economic No. 3, for Corn,	Economic Fertilizer Company, Boston, Mass.,	Boston.
89	The Economic Fertilizer for All Crops,	Baugh & Sons, Philadelphia and Baltimore,	Newburyport.
93	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
94	Stockbridge's Manure for Grapes, Raspberries, etc.,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
107	Baker's Special Corn Manure,	H. J. Baker & Bro., New York, N. Y.,	New Bedford.
109	Special Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	New Bedford.
112	N. Ward & Co.'s High-grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
121	World of Good Raw Bone Superphosphate,	Thompson & Edwards Fertilizer Company, Chicago, Ill.,	Hatfield.
130	Lister's Celebrated Onion Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	Turner's Falls.
141	Fish and Potash,	Prentiss, Brooks & Co , Holyoke, Mass.,	Holyoke.
142	Lawn Dressing,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
149	Whittemore Bros.' Bone Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
26	Cotton-hull Ashes,	H. L. Phelps, Southampton, Mass., Agent,	Sunderland.
37	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.

4. *Analyses of Commercial Fertilizers, etc.*—Concluded.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
36	Stockbridge's Manure for Onions,	10.29	4.00	3.25—4.25	7.37	2.37	1.90	11.64	8—10	9.74	7—8	4.85	5—6
40	Lawn Fertilizer, Tobacco and Sulphur,	22.46	2 60	–	–	–	–	0.014	–	–	–	7.12	–
60	Chittenden's Compound Fertilizer for Potatoes,	11.41	3.40	3.30—4.12	5.95	1.64	6 31	13.87	8—10	7.59	6—8	5.78	6—8
74	Peruvian Guano,	14.65	8.44	–	4 35	6.64	5.10	16.09	–	10.99	–	2.75	–
75	Animal Fertilizer for Lawn and Garden,	12.00	3.58	4—6	2 38	3 41	7.68	13.47	10—12	5.79	–	3.84	4—6
80	Economic No. 3, for Corn,	12 88	1 10	.25—.75	0.00	2 59	8.22	10.81	6—9	2 59	–	0.21	–
89	Economic Fertilizer for all Crops,	20 35	1.60	1.65—2.06	4 39	1.69	3 04	9.12	–	6.08	5—6	1.95	–*
93	Stockbridge's Manure for Strawberries,	13.37	2.18	2.50—3.25	6 06	1 06	6.56	13.68	7—9	7.12	6—7	3.92	–*
94	Stockbridge's Manure for Grapes, etc.,	13.70	3.18	2.50—3.25	7.16	1.15	3.29	11.60	8—10	8.31	6—8	3.58	4—5
107	Baker's Special Corn Manure,	8.04	4.58	4.12	4.89	1.56	2.07	8.52	7.50—9.50	6.45	6.50	7.32	7
109	Special Grass Manure,	15.12	3.68	3.30	4.16	0.62	2.00	6 82	–	4.78	5	5.80	7
112	N. Ward & Co., High-grade Animal Fertilizer,	14.86	3.69	2.88—3.70	5.46	6.22	0.50	12.18	–	11.68	12—14	4.15	4—5
121	World of Good Raw Bone Superphosphate,	4.72	3.04	1.65—2.47	5.14	4 29	6.28	15.71	12—14	9.43	8—10	2.10	–*
130	Lister's Celebrated Onion Fertilizer,	10 11	4 52	3 30—4 12	4.31	3.10	0.32	7.76	–	7 44	8—10	5.75	7—8
141	Fish and Potash,	7.60	3.65	3.30—4.12	2.12	1.63	1.48	5.23	5—6	3.75	–	5.12	4—6
142	Lawn Dressing,	15.21	2 92	3.30—4.12	5.94	1.22	0.50	7.66	6—8	7.16	–	8.09	7—9
149	Whittemore Bros.' Bone Fertilizer,	13.13	3.70	–	5.62	6.53	1.47	13.62	–	12.15	–	3.63	–
26	Cotton-hull Ashes,	10.70	–	–	–	–	–	10.08	–	–	–	26.04	–
37	Nitrate of Soda,	1.32	16.04	–	–	–	–	–	–	–	–	–	–

* Sulphate of potash the source of potash.

5. *Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.*

Wood Ashes.

[I., II. and III. sent on from Amherst, Mass.; IV. sent on by E. C. Smith, Rowley, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.49	9.30	0.44	7.03
Calcium oxide,	38.36	38.58	24.62	32.31
Magnesium oxide,	2.74	2.72	4.70	4.03
Sodium oxide,	2.29	1.89	–	–
Potassium oxide,	4.53	4.84	5.69	4.36
Phosphoric acid,	2.48	2.99	4.61	2.38
Insoluble matter (before calcination),	17.54	18.08	41.92	19.53
Insoluble matter (after calcination),	14.51	15.36	37.22	13.99

Wood Ashes.

[I. and II. sent on by C. H. Thompson & Co., Boston, Mass.; III. sent on by J. C. Comins, N. Amherst, Mass.; IV. sent on by Chas. N. Perley, Danvers, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.03	0.55	6.98	7.72
Calcium oxide,	22.69	33.58	37.28	42.39
Magnesium oxide,	6.15	3.74	5.13	2.65
Potassium oxide,	6.52	1.91	5.56	5.38
Phosphoric acid,	1.66	1.32	2.30	1.15
Insoluble matter (before calcination),	27.92	3.64	13.91	9.26
Insoluble matter (after calcination),	23.75	2.03	11.50	6.37

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by Frank Wheeler, Concord, Mass.; III. and IV. sent on by E. W. McGarvey, London, Ont.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	16.55	15.58	7.53	11.88
Calcium oxide,	36.59	34.20	39.61	34.87
Magnesium oxide,	3.01	2.86	2.42	3.20
Potassium oxide,	4 29	4.82	6.39	5.29
Phosphoric acid,	2.44	1.76	1.28	2.00
Insoluble matter (before calcination),	15.15	20.75	11.14	11.66
Insoluble matter (after calcination),	12.42	18.35	8.32	7.68

Wood Ashes.

[Sent on by Frank Goodwin, Framingham, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	20.33	15.54	.10	14.34
Calcium oxide,	31.21	32.77	40.01	33.82
Magnesium oxide,	3.51	3.21	3.73	3.04
Potassium oxide,	3.57	3.75	9.80	4.43
Phosphoric acid,	2.90	1.45	2.16	2.72
Insoluble matter (before calcination),	13.31	12.56	15.54	21.13
Insoluble matter (after calcination),	10.51	10 06	11.94	8.69

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. sent on by Frank Goodwin, Framingham, Mass.; II. sent on by Chas. W. Jenks, Bedford, Mass.; III. sent on by Frank E. Kimball, Danvers, Mass.; IV. sent on by C. N. Perley, Danvers, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	.15	20.40	15.64	14.46
Calcium oxide,	44.59	30.98	31.56	32.14
Magnesium oxide,	7.24	3.14	3.27	2.59
Potassium oxide,	4.27	4.26	4.12	4.36
Phosphoric acid,	3.73	1.54	1.28	2.71
Insoluble matter (before calcination),	11.70	13.53	24.10	16.48
Insoluble matter (after calcination),	10.42	10.49	13.50	13.26

Wood Ashes.

[I. sent on from Amherst, Mass.; II. sent on by Urbane Derby, Concord, Mass.; III. sent on by W. E. Allen, Lancaster, Mass.; IV. sent on by E. F. Manchester, Fall River, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	19.30	7.08	.25	4.77
Calcium oxide,	30.54	39.54	27.48	32.52
Magnesium oxide,	2.75	4.64	4.41	4.60
Potassium oxide,	5.16	3.60	5.07	4.23
Phosphoric acid,	1.77	1.95	2.28	2.07
Insoluble matter (before calcination),	14.50	14.74	39.10	24.76
Insoluble matter (after calcination),	10.20	12.53	37.75	20.04

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by J. A. Merriam, Framingham, Mass.; III. sent on by R. L. Day, South Framingham, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	19.04	21.47	14.52
Calcium oxide,	36.35	32.66	40.31
Magnesium oxide,	2.82	2.36	2.91
Potassium oxide,	4.63	3.26	2.70
Phosphoric acid,	1.65	1.70	1.47
Insoluble matter (before calcination),	8.07	8.25	7.77
Insoluble matter (after calcination),	7.15	7.86	6.78

Wood Ashes.

[I. sent on by W. H. Davis, Littleton, Mass.; II. and III. sent on by A. H. Turner, Harvard, Mass.; IV. sent on by Flagg & Russell, Warnersville, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	2.42	15.72	13.88	11.45
Calcium oxide,	36.94	28.61	34.03	27.17
Magnesium oxide,	3.24	3.00	3.07	3.37
Ferric oxide,	2.74	1.03	.49	–
Potassium oxide,	7.82	8.72	5.59	5.77
Phosphoric acid,	.51	.32	.54	1.31
Insoluble matter (before calcination),	16.43	18.49	13.51	7.08
Insoluble matter (after calcination),	12.18	12.12	11.33	5.85

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by Coolidge Bros., South Sudbury, Mass ; III. and IV. sent on by James Logan, Worcester, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C ,	15.73	11.86	24.96	15.97
Calcium oxide,	37.18	43.13	15.83	39.76
Magnesium oxide,	3.56	1.80	2.14	1.82
Potassium oxide,	5.22	3.66	3.74	2.40
Phosphoric acid,	1.57	3.84	1.89	6.10
Insoluble matter (before calcination),	6.44	7.06	16.20	8.39
Insoluble matter (after calcination),	5 61	6.41	12.50	5.93

Cotton-seed Hull Ashes.

[I. sent on by Lyman A. Crafts, Whately, Mass.; II. sent on by S. G. Hubbard, Whately, Mass.; III. sent on by A. W. Field, North Hadley, Mass.; IV. sent on by J. Comins, Sunderland, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	10.24	9.97	.86	11.96
Calcium oxide,	8.89	9.59	9.80	4.41
Magnesium oxide,	12.61	13.58	16.05	12.29
Ferric oxide,	1.14	1.54	1.92	–
Potassium oxide (6 cents per pound),	28.44	25.17	22.58	29.36
Phosphoric acid (6 cents per pound),	10.28	9.16	8.02	12.99
Insoluble matter (before calcination),	–	–	10.73	7.38
Insoluble matter (after calcination),	6.11	.96	6.50	3.68
Valuation per ton,	$46 46	$41 20	$36 72	$50 82

5. *Analyses, etc.* — Continued.

Cotton-seed Hull Ashes.

[I. and II. sent on by S. G. Hubbard, Hatfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.13	8.13
Calcium oxide,	7.26	11.34
Magnesium oxide,	10.99	11.58
Ferric oxide,	1.25	1.96
Potassium oxide (6 cents per pound),	25.35	22.66
Phosphoric acid (6 cents per pound),	10.68	8.69
Insoluble matter (before calcination),	13.59	12.70
Insoluble matter (after calcination),	11.61	9.73
Valuation per ton,	$43 24	$37 62

Sulphate of Potash.

[I. sent on from Amherst, Mass.; II. and III. sent on from Feeding Hills, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.87	7.54	8.46
Potassium oxide (6 cents per pound),	37.54	25.81	17.43
Sulphuric acid,	45.96	46.96	50.11
Insoluble matter,	.94	–	–
Valuation per ton,	$45 05	$30 97	$20 92

5. *Analyses, etc.* — Continued.

Muriate of Potash.

[Sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	4.01	2.22	2.41
Sodium oxide,	2.88	12.44	11.50
Potassium oxide (4½ cents per pound),	45.16	47.30	49.86
Chlorine,	45.67	52.00	52.00
Insoluble matter,	1.01	Trace.	Trace
Valuation per ton,	$40 64	$42 57	$44 87

Gypsum.

[I. sent on from Wellesley Hills, Mass.; II. sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	38.47	14.05
Calcium oxide,	16.21	32.65
Sulphuric acid,	21.43	41.90
Insoluble matter,	11.30	2.22

No. I. is a factory refuse article.

Lime.

[Sent on from Amherst, Mass.]

	Per Cent.
Calcium oxide,	74.79
Insoluble matter,	.77

5. *Analyses, etc.* — Continued.

South Carolina Phosphate.

[Sent on from Amherst, Mass. I., finely ground "Floats;" II., Apatite.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.39	.09
Calcium oxide,	46.76	–
Ferric and aluminic oxides,	5.78	–
Total phosphoric acid,	27.57	36.08
Soluble phosphoric acid,	0.00	–
Reverted phosphoric acid (7½ cents per pound),	4.27	–
Insoluble phosphoric acid (2 cents per pound),	23.30	–
Insoluble matter,	9.04	9.55
Valuation per ton,	$15 73	–

Mona Island Guano.

[Sent on by J. Campbell & Co., New York, N. Y.]

	Per Cent.
Moisture at 100° C.,	12.52
Ash,	75.99
Total phosphoric acid,	21.88
Soluble phosphoric acid,	.00
Reverted phosphoric acid (7½ cents per pound),	7.55
Insoluble phosphoric acid (3 cents per pound),	14.33
Calcium oxide,	37.49
Potassium oxide,	Trace.
Nitrogen (17 cents per pound),	.76
Insoluble matter,	2.45
Valuation per ton,	$22 50

5. *Analyses, etc.* — Continued.

Dissolved Bone-black.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	16.84	17.41
Ash,	56.83	56 19
Total phosphoric acid,	22.18	21.70
Soluble phosphoric acid,	14.27	15.60
Reverted phosphoric acid,	7.53	6.02
Insoluble phosphoric acid,	.38	.08
Insoluble matter,	3.92	3.99
Valuation per ton,	$34 59	$34 10

Bone Coal.

[Sent on by Chas. S. Young, Wellesley Hills, Mass.]

	Per Cent.
Moisture at 100° C.,	18 16
Ash,	72.24
Total phosphoric acid,	25.58
Soluble phosphoric acid (8 cents per pound),	.38
Reverted phosphoric acid (7½ cents per pound),	5.18
Insoluble phosphoric acid (5 cents per pound),	20.02
Insoluble matter,	.69
Valuation per ton,	$28 40

5. *Analyses, etc.* — Continued.

Ground Bones.

[I., II. and III. sent on by Geo. Frost, Boston, Mass.; IV. sent on by L. B. Smith, Eastham, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	28.96	56.50	33.25	50.78
Fine medium, smaller than $\frac{1}{25}$ inch,	59.98	38.18	28.65	49.22
Medium, smaller than $\frac{1}{12}$ inch,	11.06	5.32	21.78	–
Coarser than $\frac{1}{12}$ inch,	–	–	16.32	–
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	5.59	5.85	4.18	5.34
Ash,	58.07	38.79	49.80	64.17
Total phosphoric acid,	20.08	19.90	19.32	27.22
Soluble phosphoric acid,	.30	.17	.37	.54
Reverted phosphoric acid,	5.46	7 86	9.36	9.34
Insoluble phosphoric acid,	14.32	12.67	9 59	17.34
Nitrogen,	3.88	5.90	4.72	–
Insoluble matter,	1.48	.48	.40	.46

5. *Analyses, etc.* — Continued.

Bones.

[I. sent on by Edward H. Smith, Northborough, Mass.; II. sent on by Franklyn Howland, New Bedford, Mass.; III. sent on by Edmund Hersey, Hingham, Mass.; IV. sent on by S. Winter, Brockton, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	37.90	46.00	62.29	57.33
Fine medium, smaller than $\frac{1}{25}$ inch,	38.30	36.52	30.81	24.13
Medium, smaller than $\frac{1}{12}$ inch,	19.50	17.48	6.28	9.74
Coarser than $\frac{1}{12}$ inch,	4.30	–	.62	8.80
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	4.33	4.21	5.07	8.03
Ash,	57.06	74.04	55.04	60.60
Total phosphoric acid,	22.40	29.42	25.19	23.66
Soluble phosphoric acid,	.43	.45	.14	.51
Reverted phosphoric acid,	6.17	13.17	10.80	12.18
Insoluble phosphoric acid,	15.80	15.80	14.25	10.97
Nitrogen,	4.04	2.08	3.07	4.20
Insoluble matter,	1.65	.31	.55	.72

Dried Blood.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	15.02
Nitrogen (19 cents per pound),	8.24
Valuation per ton,	$31 31

5. *Analyses, etc.* — Continued.

Sulphate of Ammonia.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.43
Nitrogen (19 cents per pound),	20.91
Sulphuric acid,	57.26
Valuation per ton,	$79 46

Nitrate of Soda.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.22	1.98
Sodium oxide,	53.44	59.56
Nitrogen (17 cents per pound),	15.30	16.00
Insoluble matter,	.19	.05
Valuation per ton,	$52 02	$54 40

Saltpetre Waste (from Gunpowder Works).

[Sent on by A. N. Stowe, Hudson, Mass.]

	Per Cent.
Moisture at 100° C.,	2.12
Calcium oxide,	.22
Magnesium oxide,	.16
Sodium oxide,	50.54
Potassium oxide (4½ cents per pound),	1.85
Sulphuric acid,	.71
Nitrogen (17 cents per pound),	.59
Chlorine,	59.00
Insoluble matter,	.18
Valuation per ton,	$3 68

5. *Analyses, etc.* — Continued.

Wool Waste.

[I. sent on by F. D. Barker, South Acton, Mass.; II. sent on by C. W. Mann, Methuen, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.53	3.46
Ash,	–	59.41
Potassium oxide (4¼ cents per pound),	Trace.	3.08
Phosphoric acid (6 cents per pound),	.115	.29
Nitrogen (8 cents per pound),	10.195	1.18
Insoluble matter,	3.480	49.57
Valuation per ton,	$16 45	$4 86

"Mud Crab."

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	7.67
Ash,	6.71
Total phosphoric acid (6 cents per pound),	1.25
Soluble phosphoric acid,	.28
Reverted phosphoric acid,	.62
Insoluble phosphoric acid,	.35
Nitrogen (17 cents per pound),	8.84
Insoluble matter,	.91

Tobacco Dust.

[Sent on from Syracuse, N. Y.]

	Per Cent.
Moisture at 100° C.,	12.98
Potassium oxide (4¼ cents per pound),	9.04
Phosphoric acid (6 cents per pound),	2.09
Nitrogen (17 cents per pound),	3.00
Insoluble matter,	.40
Valuation per ton,	$20 39

5. *Analyses, etc.* — Continued.

Cotton-seed Meal.

[Sent on from Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	5.77	6.27	8.44
Calcium oxide,	.38	.42	.378
Magnesium oxide,	.98	1.07	1.200
Potassium oxide (4¼ cents per pound),	.87	.96	2.017
Phosphoric acid (6 cents per pound),	1.42	1.57	3.165
Nitrogen (15 cents per pound),	5.96	6.56	7.220
Insoluble matter,	.59	.73	.121
Valuation per ton,	$20 32	$22 37	$27 17

Gluten Meal.

[Sent on by W. E. Dennis, Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	7.850
Calcium oxide,	.045
Magnesium oxide,	.042
Ferric oxide,	.090
Sodium oxide,	.111
Potassium oxide (4¼ cents per pound),	.030
Phosphoric acid (6 cents per pound),	.501
Nitrogen (17 cents per pound),	6.060
Insoluble matter,	1.680
Valuation per ton,	$21 23

5. *Analyses, etc.* — Continued.

Linseed Refuse.

[Sent on by John King, South Framingham, Mass.]

	Fine.	Coarse.
Moisture at 100° C.,	6.440	6.230
Ash,	7.370	5.330
Potassium oxide (4¼ cents per pound),	.679	.802
Phosphoric acid (6 cents per pound),	1.525	1.188
Nitrogen (15 cents per pound),	7.080	4.680
Insoluble matter,	.495	.112
Valuation per ton,	$28 84	$22 29

Cotton-seed Fertilizer.

[Sent on by Geo. W. Wright, Concord, Mass.]

	Per Cent.
Moisture at 100° C.,	7.950
Calcium oxide,	.429
Magnesium oxide,	.672
Ferric oxide,	.066
Potassium oxide (4¼ cents per pound),	1.194
Phosphoric acid (6 cents per pound),	1.241
Nitrogen (15 cents per pound),	8.000
Insoluble matter,	1.187
Valuation per ton,	$26 50

Oak Leaves.

[Sent on by W. H. Hillman, Forestdale, Mass.]

	Per Cent.
Moisture at 100° C.,	9.601
Ash,	6.840
Calcium oxide,	.548
Magnesium oxide,	.267
Ferric oxide,	.027
Potassium oxide (4¼ cents per pound),	.058
Phosphoric acid (6 cents per pound),	.549
Nitrogen (17 cents per pound),	.930
Soluble silica,	.018
Insoluble silica,	4.333
Valuation per ton,	$3 87

5. *Analyses, etc.* — Continued.

Chaff from Grain Elevator.

[Sent on by S. H. Pierce, Lincoln, Mass.]

	Per Cent.
Moisture at 100° C.,	9.89
Ash,	10.74
Potassium oxide (4¼ cents per pound),	.76
Phosphoric acid (6 cents per pound),	5.00
Nitrogen (17 cents per pound),	1.62
Insoluble matter,	6.49
Valuation per ton,	$12 16

Jute Waste.

[Sent on by J. E. Stevens, Ludlow, Mass.]

	Per Cent.
Moisture at 100° C.,	10.847
Ash,	23.610
Calcium oxide,	1.496
Ferric oxide,	.671
Potassium oxide (4¼ cents per pound),	.080
Phosphoric acid (6 cents per pound),	.720
Nitrogen (13 cents per pound),	1.794
Insoluble matter,	19.090
Valuation per ton,	$5 59

Hemp Waste.

[Sent on by J. E. Stevens, Ludlow, Mass.]

	Per Cent.
Moisture at 100° C.,	12.272
Ash,	6.340
Calcium oxide,	1.654
Ferric oxide,	.307
Potassium oxide (4¼ cents per pound),	.232
Phosphoric acid (6 cents per pound),	.242
Nitrogen (13 cents per pound),	1.095
Insoluble matter,	2.481
Valuation per ton,	$3 26

Cranberry Vines.

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	13.070
Ash,	2.450
Calcium oxide,	.404
Magnesium oxide,	.253

5. *Analyses, etc.* — Continued.

	Per Cent.
Ferric oxide,	.087
Sodium oxide,	.080
Potassium oxide (4¼ cents per pound),	.329
Phosphoric acid (6 cents per pound),	.268
Nitrogen (17 cents per pound),	.770
Insoluble matter,	.834
Valuation per ton,	$3 22

Salt Hay.

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	5.360
Calcium oxide,	.371
Magnesium oxide,	.335
Ferric oxide,	.028
Sodium oxide,	.017
Potassium oxide (4¼ cents per pound),	.718
Phosphoric acid (6 cents per pound),	.248
Nitrogen (17 cents per pound),	1.180
Valuation per ton,	$4 92

Compound Fertilizers.

[I. sent on by H. D. Graves, Sunderland, Mass.; II. sent on by S. G. Hubbard, Whately, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	14.17	8.92
Total phosphoric acid,	15.79	6.86
Soluble phosphoric acid,	6.88	4.77
Reverted phosphoric acid,	4.43	1.58
Insoluble phosphoric acid,	4.48	.51
Potassium oxide,	2.56	10.31
Nitrogen,	2.60	6.82
Insoluble matter,	5.44	3.67

5. *Analyses, etc.* — Continued.

Compound Fertilizers.

[I. sent on by C. A. Bartlett, Worcester, Mass.; II. sent on by E. C. Smith, Rowley, Mass.; III. sent on by W. H. Porter, Agawam, Mass.; IV. sent on by F. W. J. Gerrish, North Worcester, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	17.92	8.71	6.41	18.97
Ash,	56.65	60.15	72.65	48.25
Total phosphoric acid,	7.87	16.71	15.04	11.03
Soluble phosphoric acid,	3.55	4.53	5.44	7.16
Reverted phosphoric acid,	1.99	3.67	4.29	3.42
Insoluble phosphoric acid,	2.33	8.51	5.31	.45
Potassium oxide,	3.78	4.70	2.16	3.56
Nitrogen,	2.06	3.12	2.42	2.24
Insoluble matter,	9.93	5.55	7.50	5.30

Barn-yard Manure.

[Sent on from Amherst.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	73.470	73.520	76.160	73.470
Organic and volatile matter,	85.900	93.087	95.915	96.671
Ash,	14.100	6.913	4.085	3.329
Calcium oxide,	.264	.185	.302	.322
Magnesium oxide,	.182	.158	.180	.124
Potassium oxide (4½ cents per pound),	.615	.487	.804	.484
Phosphoric acid (6 cents per pound),	.133	.189	.218	.247
Nitrogen (17 cents per pound),	.362	.338	.570	.471
Insoluble matter,	12.657	6.038	2.131	2.285
Valuation per ton,	$1 94	$1 82	$2 92	$2 34

5. *Analyses, etc.* — Concluded.

Barn-yard Manure.

[Sent on from Amherst.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	70.160	56.710	72.810
Organic volatile matter,	86.553	87.526	95.809
Ash,	13.447	12.474	4.191
Calcium oxide,	.323	.386	–
Magnesium oxide,	.271	.223	–
Potassium oxide (4½ cents per pound),	.614	.486	.562
Phosphoric acid (6 cents per pound),	.553	.399	.745
Nitrogen (17 cents per pound),	.486	.419	.672
Insoluble matter,	11.991	9.873	2.250
Valuation per ton,	$2 86	$2 34	$3 68

No. III. From State Experiment Station.

6. *Miscellaneous Analyses.*

Ensilage Liquor.

[Sent on by James Cheesman, Boston, Mass. Specific gravity, 1.015; temperature, 17° C.]

	Per Cent.
Acidity (calculated to acetic acid),	2.66
Moisture at 100° C.,	96.21
Dry matter,	3.79
Ash,	.91
Calcium oxide,	.015
Magnesium oxide,	.003
Ferric oxide,	.227
Sodium oxide,	.001
Potassium oxide,	.155
Phosphoric acid,	.001
Nitrogen as ammoniates,	.023
Nitrogen as nitrates,	.008
Nitrogen as albuminoids,	.002
Nitrogen, total,	.056

6. *Miscellaneous Analyses* — Concluded.

"*Nicotinia*" (*Insecticide*).

[Sent on from Syracuse, N. Y.]

	Per Cent.
Moisture at 100° C.,	10.00
Ash,	27.37
Calcium oxide,	4.45
Magnesium oxide,	.90
Potassium oxide ($4\frac{1}{4}$ cents per pound),	9.15
Phosphoric acid (6 cents per pound),	.67
Nitrogen (17 cents per pound),	2.49
Insoluble matter,	2.12
Valuation per ton,	$17 05

Hellebore (*Insecticide*).

[Sent on by Joseph Breck & Son, Boston, Mass.]

	Per Cent. I.	Per Cent. II.
Ash,	6.97	41.36
One hundred parts of ash contained: —		
Ferric and aluminic oxides,	–	7.11
Insoluble matter,	33.65	92.16

No. II. was evidently adulterated with ground clay.

Peroxide of Silicate (*Insecticide*).

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.65
Calcium oxide,	41.18
Sulphuric acid,	49.66
Arsenious oxide,	.57
Copper oxide,	.33
Insoluble matter,	2.31

Gypsum, with a trace of Paris green.

II. Analyses of Water sent on for Examination.

[Parts per million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1,	.03	.06	Trace.	41.00	11.00	1.11	None.	Upton.
2,	.02	.07	5.00	45.00	10.00	1.27	None.	Amherst.
3,	.10	.14	13.00	157.00	89.00	3.25	None.	Amherst.
4,	.04	.15	32.00	203.00	118.00	3.25	None.	Amherst.
5,	.02	.04	11.00	96.00	24.00	1.27	Present.	Framingham.
6,	.05	.08	12.00	108.00	30.00	2.60	None.	Framingham.
7,	.02	.01	10.00	72.00	44.00	2.73	–	Hinsdale.
8,	.03	.07	9.00	160.00	85.00	3.25	None.	Amherst.
9,	.02	.04	24.00	146.00	46.00	3.12	None.	Amherst.
10,	.68	.18	Trace.	45.00	5.00	1.27	None.	Amherst.
11,	.12	.04	6.00	25.00	5.00	0.00	–	Ashfield.
12,	.08	.04	Trace.	68.00	28.00	2.86	–	Ashfield.
13,	.03	.06	7.00	58.00	40.00	0.00	None.	Bedford.
14,	.04	.28	22.00	135.00	70.00	3.38	None.	Westford.
15,	.05	.18	20.00	85.00	20.00	3.38	–	Westford.
16,	.99	.15	96.00	558.00	325.00	13.01	None.	South Deerfield.
17,	.03	.07	Trace.	70.00	45.00	1.56	None.	North Amherst.
18,	.03	.07	30.00	85.00	18.00	2.60	Present.	Amherst.
19,	.04	.07	Trace.	93.00	30.00	3.90	None.	Amherst.
20,	.04	.12	Trace.	60.00	30.00	0.00	None.	Ashby.
21,	.03	.09	4.00	130.00	68.00	2.73	None.	East Amherst.
22,	.03	.05	7.00	91.00	43.00	.79	None.	North Leverett.
23,	.01	.05	10.00	60.00	15.00	.32	Present.	Shutesbury.
24,	.52	1.80	40.00	765.00	410.00	9.71	–	Amherst.
25,	.40	.12	7.00	92.00	22.00	6.43	Present.	Amherst.
26,	.01	.01	78.00	389.00	139.00	7.83	–	Amherst.
27,	.46	.07	Trace.	57.00	12.00	2.60	None.	Amherst.
28,	.33	.08	Trace.	74.00	27.00	2.34	Present.	Amherst.
29,	.03	.06	12.00	135.00	70.00	3.64	None.	Amherst.

II. Analyses of Water — Continued.

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 160° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
30,	.01	.06	Trace.	112.00	42.00	2.47	None.	East Amherst.
31,	.04	.05	Trace.	46.00	10.00	.47	None.	Amherst.
32,	.13	.10	6.00	147.00	92.00	4.57	None.	South Amherst.
33,	.17	.06	6.00	111.00	66.00	4.57	None.	Amherst.
34,	.84	.10	34.00	370.00	137.00	6.71	None.	Sunderland.
35,	.05	.05	6.00	88.00	42.00	2.21	–	Amherst.
36,	.01	.03	8.00	180.00	80.00	3.90	None.	Leverett.
37,	.01	.01	Trace.	30.00	00.00	1.11	None.	Amherst.
38,	.01	.10	12.00	95.00	5.00	1.95	–	Amherst.
39,	.01	.16	Trace.	49.00	10.00	2.34	None.	South Boston.
40,	.05	.12	Trace.	47.00	9.00	2.34	None.	South Boston.
41,	.03	.03	7.00	93.00	51.00	2.73	None.	Amherst.
42,	.21	.07	3.00	61.00	25.00	2.21	None.	North Amherst.
43,	.02	.07	22.00	168.00	78.00	4.57	None.	Amherst.
44,	.03	.16	Trace.	52.00	12.00	.32	–	Amherst.
45,	.05	.03	Trace.	74.00	18.00	1.95	None.	South Amherst
46,	.06	.13	8.00	128.00	68.00	2.60	Present.	Amherst.
47,	.01	.12	Trace.	40.00	6.00	.32	–	Amherst.
48,	.03	.10	Trace.	42.00	20.00	.32	–	Amherst.
49,	.03	.11	10.00	158.00	90.00	2.34	–	Amherst.
50,	.01	.04	Trace.	50.00	38.00	1.27	None.	Amherst.
51,	.03	.24	Trace.	50.00	8.00	.16	–	Amherst.
52,	.14	.22	Trace.	140.00	86.00	4.57	–	Amherst.
53,	.01	.06	5.00	110.00	90.00	2.34	None.	Amherst.
54,	.10	.26	6.00	74.00	42.00	4.16	None.	Hudson.
55,	.72	.16	13.00	156.00	98.00	5.29	–	Amherst.
56,	.06	.26	7.00	68.00	22 00	.79	None.	Ashburnham.
57,	.12	.08	10.00	90.00	30.00	2.60	–	Bedford.
58,	.08	.08	35.00	210.00	160.00	5.29	Present.	Bedford.
59,	.00	.04	8.00	77.00	47.00	2.21	–	Bedford.

II. ANALYSES OF WATER — Concluded.

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
60,	.01	.03	8.00	70.00	35.00	1.95	None.	Bedford.
61,	.01	.06	6.00	75.00	40.00	.48	None.	East Deerfield.
62,	.00	.03	4.00	20.00	00.00	.00	None.	East Deerfield.
63,	.01	.02	8.00	75.00	40.00	2.21	None.	North Amherst.
64,	.02	.07	7.00	138.00	78.00	1.56	None.	Deerfield.
65,	.01	.03	21.00	178.00	150.00	2.60	None.	Amherst.
66,	.09	.05	19.00	68.00	50 00	2.60	None.	Amherst.
67,	.01	.05	7.00	78.00	18.00	.48	None.	North Hadley.
68,	.08	.06	11.00	114 00	56.00	2.86	None.	East Buckland.
69,	.03	.10	10.00	96.00	68.00	2.99	–	Buckland.
70,	.05	.07	17.00	280.00	190.00	2.86	–	Sunderland.
71,	.06	.05	20.00	236.00	146.00	4.57	None.	Amherst.
72,	Trace.	.02	10.00	88.00	26.00	1.95	None.	North Amherst.
73,	.01	.05	6.00	40.00	18.00	1.43	None.	North Amherst.
74,	Trace.	.03	4.00	16.00	6 00	.16	None.	North Amherst.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2.* Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per

* One gallon equals 70,000 grains.

million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

The American Association of Official Chemists has appointed a committee to investigate the subject of analyses of water for family use, and to advise upon some uniform method of investigation and of reporting the results. As soon as their recommendation shall be endorsed by the association, we propose to be guided by that decision.

An examination of the previously stated results of analyses, indicate that Nos. 3, 5, 10, 11, 16, 18, 23, 24, 25, 27, 28, 32, 33, 34, 42, 46, 52, 54, 57 and 58, ought to be condemned as unfit for family use, while Nos. 12, 56, 66 and 68 must be considered suspicious. From this record it will be seen that over one-fourth of the entire number of well waters tried proved unfit for drinking. Heating well waters to the boiling point removes, not unfrequently, immediate danger. Seven samples gave unmistakable evidence of the presence of lead.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by W. H. Beal.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1890.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse Salts, Ashes, etc.																							
Muriate of potash,	45	2.00	–	–	–	–	58.98	45.94	**52.46**	–	–	–	–	–	–	6.69	–	.55	–	–	–	48.60	.75
Sulphate of potash,	15	1.25	–	–	–	–	51.28	21.36	**38.60**	–	–	–	–	–	–	4.46	–	1.50	–	45.72	–	–	.75
Sulphate of potash and magnesia,	13	4.75	–	–	–	–	27.77	18.92	**23.50**	–	–	–	–	–	–	6.25	2.57	12.25	–	44.25	–	2.60	1.41
Kainite,	3	3.20	–	–	–	–	16.48	12.51	**13.54**	–	–	–	–	–	–	18.97	1.12	10.25	–	21.05	–	34.32	1.27
Carnallite,	1	–	–	–	–	–	–	–	**13.68**	–	–	–	–	–	–	7.66	–	13.19	–	.56	–	41.56	–
Krugite,	1	4.82	–	–	–	–	–	–	**8.42**	–	–	–	–	–	–	5.57	12.45	8.79	–	31.94	–	6.63	14.96
Sulphate of magnesia (*Kieserite*),	9	22.20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.82	17.30	–	36.10	–	–	5.73
Nitrate of potash,	2	1.93	–	14.58	11.60	**13.09**	45.62	44.76	**45.19**	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nitrate of soda,	14	1.40	–	16.01	15.30	**15.75**	–	–	–	–	–	–	–	–	–	35.25	–	–	–	–	–	.50	.50
Sulphate of ammonia,	23	1.00	–	21.68	19.70	**20.50**	–	–	–	–	–	–	–	–	–	–	–	–	–	60.00	–	–	trace
Saltpetre waste,	8	2.75	–	3.30	.59	**2.43**	30.94	1.85	**15.50**	–	–	–	–	–	–	34.25	.75	.19	–	1.85	–	48.30	–
Nitre salt-cake,	2	6.03	–	–	–	**2.29**	–	–	**.87**	–	–	–	–	–	–	29.56	–	–	–	47.77	–	–	3.92
Wood ashes,	116	12.00	–	–	–	–	7.95	2.93	**5.25**	4.61	.51	**1.75**	–	–	–	–	34.80	3.25	.83	–	–	–	12.50
Cotton-seed hull ashes,	20	7.33	–	–	–	–	42.12	17.34	**23.80**	13.67	2.80	**8.50**	–	–	–	–	9.50	11.25	1.60	–	–	–	11.79
Ashes of spent tan-bark,	3	6.31	–	–	–	–	2.87	1.14	**2.04**	2.77	.13	**1.61**	–	–	–	–	33.46	3.55	–	–	–	–	24.33

Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue-works,	1	12.74	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	7	15.45	-	-	-	-	1.70	.02	.86	3.16	.36	1.18	-	-	-	-	44.80	2.60	-	-	17.75	-	8.25
Marls (Massachusetts),	5	18.18	-	-	-	-	-	-	-	2.72	.06	1.05	-	-	-	-	40.07	.64	.69	-	28.51	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano, from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Cuba guano,	5	24.27	.67	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (*Orchilla*),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.08	-	-	1.27
South Carolina rock phosphate,	4	1.50	-	-	-	-	-	-	-	30.51	25.81	28.03	.27	.33	27.43	-	41.87	3.03	4.80	-	-	-	11.61
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	34.27	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	35.21	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	3	1.45	-	-	-	-	-	-	-	30.51	18.91	23.49	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
II. Guanos, Phosphates, etc.—Concluded.																							
Bone-black,	5	4.69	-	-	-	-	-	-	-	30.54	16.56	28.28	-	-	-	-	-	-	-	-	-	-	3.64
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	35.89	-	-	-	-	44.89	-	-	-	-	-	4.50
III. Refuse Substances.																							
Dried blood,	12	12.50	6.37	13.55	8.10	10.52	-	-	-	6.23	1.53	1.91	-	-	-	-	-	-	-	-	-	-	-
Ammonite,	1	5.88	-	-	-	11.33	-	-	-	-	-	3.43	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	12.12	-	-	-	-	-	.88	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	5.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.44
Sponge refuse,	1	7.25	-	-	-	2.43	-	-	-	-	-	3.19	-	-	-	-	3.94	1.27	-	-	-	-	39.05
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
Raw wool,	1	6.95	7.54	-	-	12.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste,	5	9.27	-	10.20	1.18	5.64	3.08	.51	1.30	-	-	.29	-	-	-	-	.07	.07	-	-	-	-	4.60
Wool washings (water),	1	-	-	-	-	-	-	-	3.92	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid),	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline),	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22

Meat mass,	5	12.09	13.60	11.50	9.69	10.44	–	–	–	3.58	.56	2.07	–	–	–	–	–	–	–	–	–	–	.58
Bone soup,	1	82.92	7.07	–	–	1.14	–	–	–	–	–	1.26	–	–	–	–	–	–	–	–	–	–	–
Dried soup from meat and bone,	1	14.80	8.40	–	–	9.97	–	–	–	–	–	.53	–	–	–	–	–	–	–	–	–	–	.64
Dried soup from rendering cattle feet,	1	10.80	7.56	–	–	14.47	–	–	–	–	–	.46	–	–	–	–	–	–	–	–	–	–	.26
Dried soup from horse rendering,	1	92.14	–	–	–	1.12	–	–	–	–	–	.14	–	–	–	–	–	–	–	–	–	–	–
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	–	–	–	15.37	11.04	13.21	–	–	–	–	–	–	–	–	–	–	1.29
Bones,	106	7.47	56.07	4.70	1.62	4.12	–	–	–	27.76	18.58	23.50	.43	7.85	15.22	–	–	–	–	–	–	–	1.25
Tankage,	13	13.20	28.75	8.07	4.60	6.82	–	–	–	16.94	8.76	11.25	.27	4.75	6.23	–	–	–	–	–	–	–	1.23
Fish with less than 20 per cent. water,	49	12.75	21.50	11.40	6.81	7.25	–	–	–	11.26	5.50	8.25	.55	2.50	5.10	–	–	–	–	–	–	–	2.20
Fish with between 20 and 40 per cent. water,	9	29.34	19.14	7.41	4.22	5.81	–	–	–	8.32	4.68	7.25	.82	2.87	3.56	–	–	–	–	–	–	–	1.85
Fish with over 40 per cent. water,	10	45.46	15.50	7.60	2.43	4.97	–	–	–	8.56	2.94	5.08	1.17	1.33	2.58	–	–	–	–	–	–	–	1.35
Whale meat, raw,	1	44.50	1.04	–	–	4.86	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lobster shells,	1	7.27	–	–	–	4.50	–	–	–	–	–	3.52	–	–	–	–	22.24	1.30	–	–	–	–	.27
Castor-bean pomace,	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	–	–	–	–	.87	.29	–	–	–	–	1.75
Cotton-seed meal,	7	6.80	5.77	7.26	4.02	6.66	2.09	.89	1.62	3.16	1.26	1.45	–	–	–	–	.39	.99	–	–	–	–	.60
Rotten brewer's grain,	1	78.77	–	–	–	.72	–	–	.04	–	–	.43	–	–	–	–	.26	.15	–	–	–	–	.59
Tobacco stems,	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	–	–	–	.34	3.89	1.23	–	–	–	–	.82
Cotton waste (wet),	1	34.69	–	–	–	1.30	–	–	.80	–	–	1.54	–	–	–	–	2.45	1.13	–	–	–	–	41.33
Cotton waste (dry),	2	6.89	–	2.09	1.32	1.71	1.62	.89	1.26	.84	.83	.84	–	–	–	–	1.99	.77	–	–	–	–	34.89
Cotton dust,	1	34.46	50.93	–	–	.50	–	–	.19	–	–	.21	–	–	–	–	.90	.90	–	–	–	–	47.46
Glucose refuse,	1	8.10	–	–	–	2.62	–	–	.15	–	–	.29	–	–	–	–	.18	.02	–	–	–	–	.07
Hop refuse,	1	8.98	–	–	–	.98	–	–	.11	–	–	.20	–	–	–	–	.27	.10	–	–	–	–	.63

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances—Concluded.																							
Sumac waste,	1	63.06	6.80	–	–	1.19	–	–	3.25	–	–	–	–	–	–	–	1.14	3.25	–	–	–	–	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	–	–	–	1.63	2.13	.11	–	–	–	–	1.06
Rockweed, green,	1	68.50	23.70	–	–	.62	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rockweed, dry,	1	10.68	35.75	–	–	1.45	–	–	4.89	–	–	2.75	–	–	–	7.90	7.66	.21	–	–	–	–	10.40
Wet kelp,	1	88.04	2.26	–	–	.26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mussel mud, wet,	1	60.01	27.29	–	–	.21	–	–	6.17	–	–	.10	–	–	–	.70	.93	.14	3.48	–	–	–	–
Mussel mud, dry,	1	2.24	72.02	–	–	.72	–	–	–	–	–	.35	–	–	–	–	23.39	–	8.26	–	–	–	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	–	–	–	–	–	–	.94	.91	.37	4.13	–	–	–	34.88
Fresh-water mud,	1	40.37	–	–	–	1.37	–	–	.22	–	–	.26	–	–	–	–	1.27	.29	1.80	–	–	–	18.26
Black mud,	1	56.55	39.60	–	–	1.64	–	–	.38	–	–	–	–	–	–	.86	.91	.66	4.26	–	–	–	31.84
Muck,	12	55.13	13.75	2.54	.26	1.12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Peat,	9	61.50	7.71	1.40	.41	.75	–	–	–	–	–	–	–	–	–	–	.50	–	–	–	–	–	.38
Turf,	1	19.29	6.36	1.97	1.91	1.94	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Soot,	1	5.54	77.10	–	–	–	–	–	1.83	–	–	–	–	–	–	–	–	–	–	–	–	–	35.34

IV. Animal Excrement.																							
Barn-yard manure,	7	73.27	8.36	.67	.34	.47	.80	.48	.58	.75	.13	.36	–	–	–	–	.30	.19	–	–	–	–	6.75
Poudrette, dry,	1	5.25	35.45	–	–	3.58	–	–	.49	–	–	5.74	–	–	–	–	–	–	–	–	–	–	4.65
Hen manure, fresh,	1	45.73	–	–	–	.79	–	–	.18	–	–	.47	–	–	–	–	.97	–	–	–	–	–	39.32
Hen manure, dry,	1	8.35	–	–	–	2.13	–	–	9.94	–	–	2.02	–	–	–	–	2.22	.62	–	–	–	–	34.64

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

1868-1890.

Prepared by W. H. Beal.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

A. Analyses of Fodder Articles.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN—FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	23	30.53	10.34	**19.14**	17.19	8.04	**10.33**	6.10	1.42	**2.42**	63.13	42.02	**55.30**	31.53	19.26	**25.97**	5.98	1:7.99
Fodder corn (ensilaged),	16	28.40	13.12	**20.30**	12.58	6.91	**8.64**	6.07	1.94	**3.84**	65.69	42.99	**56.44**	35.25	17.67	**26.29**	4.99	1:10.22
Sorghum,	6	23.18	12.38	**17.41**	11.84	7.46	**8.74**	2.00	1.21	**1.55**	64.93	47.65	**56.15**	29.27	22.00	**26.73**	6.83	1:11.62
White kibi,*	2	24.26	22.85	**23.56**	15.14	10.79	**12.97**	1.61	1.50	**1.56**	53.66	52.30	**52.91**	31.70	23.03	**27.37**	5.19	–
Mochi millet,*	3	42.27	30.07	**37.42**	11.90	6.11	**9.94**	1.94	1.74	**1.81**	67.08	49.06	**55.69**	29.80	20.01	**25.56**	7.00	–
Mix,*	3	31.36	18.17	**24.45**	16.70	9.81	**13.53**	2.48	1.35	**1.86**	52.30	47.75	**51.27**	27.44	26.82	**27.06**	6.28	–
Green oats,	5	28.82	15.51	**20.03**	20.47	7.05	**13.85**	3.32	2.02	**2.68**	50.69	40.81	**45.90**	33.12	25.2	**29.70**	7.87	1:9.97
Timothy (*Phleum pratense* L.),	2	35.00	34.26	**34.63**	8.83	8.20	**8.52**	2.07	1.95	**2.01**	51.33	51.23	**51.27**	33.23	32.50	**32.87**	5.33	1:10.96
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	**25.93**	–	–	**9.38**	–	–	**1.01**	–	–	**57.80**	–	–	**24.66**	7.15	1:6.86
Vetch and oats (1 part vetch, 9 parts oats),	2	24.04	13.89	**18.97**	10.76	10.59	**10.68**	2.74	2.29	**2.52**	43.75	40.10	**41.91**	35.81	34.20	**35.01**	9.88	1:6.85
Horse bean (*Vicia faba* L.),	1	–	–	**15.17**	–	–	**16.68**	–	–	**2.31**	–	–	**47.09**	–	–	**28.17**	5.75	1:2.71
Cow-pea vines,	3	21.19	18.15	**19.63**	17.93	11.24	**14.59**	2.99	1.81	**2.48**	60.62	46.13	**52.42**	25.88	21.87	**23.59**	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	2	19.42	15.40	**17.41**	17.75	12.17	**14.96**	2.65	2.09	**2.37**	41.54	35.45	**38.49**	38.76	26.21	**32.49**	11.69	1:4.67
White lupine (*Lupinus albus* L.),	1	–	–	**14.65**	–	–	**18.71**	–	–	**2.41**	–	–	**42.67**	–	–	**31.18**	5.03	–
Spanish moss (*Tillandsia usneoides* L.),	1	–	–	**39.20**	–	–	**4.45**	–	–	**2.54**	–	–	**57.73**	–	–	**32.61**	2.67	–

II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	5	91.94	89.11	90.28	10.13	9.02	9.54	2.65	2.09	2.49	54.43	47.11	49.26	35.55	29.21	32.28	6.43	1:11.85
Rowen (of mixed hay),	4	91.16	80.29	86.10	14.70	11.63	13.45	5.03	2.60	3.91	63.52	41.92	45.48	31.50	25.11	28.88	8.28	1:6.36
Timothy hay (*Phleum pratense* L.),	4	92.76	89.45	91.43	9.02	7.24	8.32	2.65	1.95	2.20	54.43	50.01	51.73	36.59	29.21	32.90	4.85	1:11.44
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.63	34.11	31.12	32.92	4.97	1:12.06
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	4	92.60	87.84	90.18	7.27	5.89	6.49	2.17	1.65	1.84	49.18	43.95	47.37	39.90	34.46	36.26	8.04	1:14.32
Perennial rye grass (*Lolium perenne* L.),	4	93.64	90.50	92.60	16.56	6.59	11.71	3.15	1.59	2.37	55.77	38.82	48.14	30.86	26.79	29.64	8.14	1:7.40
Italian rye grass (*Lolium Italicum* A Br.),	4	92.62	90.70	91.54	9.75	6.20	8.15	2.07	1.39	1.85	52.80	43.09	49.14	36.90	31.27	33.34	7.52	1:10.90
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	92.55	–	–	9.45	–	–	2.22	–	–	50.64	–	–	31.96	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	–	–	93.35	–	–	15.27	–	–	1.95	–	–	38.24	–	–	33.72	10.82	1:2.94
Low meadow hay,	1	–	–	91.99	–	–	9.51	–	–	1.88	–	–	46.27	–	–	35.59	6.75	–
Millet,	5	93.85	91.90	93.00	8.11	7.09	7.59	2.67	.89	1.74	55.80	49.62	51.64	35.91	29.80	33.54	5.49	1:7.78
Oats in blossom,	1	–	–	93.57	–	–	6.58	–	–	2.92	–	–	50.03	–	–	34.06	6.41	1:14.23
Oats in milk,	1	–	–	90.45	–	–	10.89	–	–	2.69	–	–	46.02	–	–	34.32	6.08	1:7.90
Oats, ripe,	1	–	–	91.30	–	–	6.05	–	–	2.61	–	–	48.92	–	–	36.31	6.11	1:15.03
Winter rye, in bloom,	1	–	–	91.45	–	–	10.66	–	–	2.57	–	–	47.40	–	–	32.97	6.40	1:8.28
Barley, in milk,	1	–	–	89.75	–	–	10.26	–	–	2.76	–	–	52.91	–	–	29.12	4.95	1:9.59
Corn fodder,	3	93.35	91.17	92.62	8.63	6.17	7.21	2.06	1.11	1.53	55.68	53.86	54.98	33.75	29.05	31.40	4.88	1:11.85
Corn stover,	11	94.23	49.87	81.08	12.15	6.04	7.92	2.63	1.17	1.65	63.05	44.65	53.38	38.24	20.93	32.02	5.03	1:10.88

* Japanese fodder plants.

A. Analyses of Fodder Articles — Continued.

NAME.	Analyses.	Dry Matter. Max.	Dry Matter. Min.	Dry Matter. Aver.	Protein. Max.	Protein. Min.	Protein. Aver.	Fat. Max.	Fat. Min.	Fat. Aver.	Nitrogen—Free Extract. Max.	Nitrogen—Free Extract. Min.	Nitrogen—Free Extract. Aver.	Fibre. Max.	Fibre. Min.	Fibre. Aver.	Ash.	Nutritive Ratio (Average).
					One Hundred Parts of Dry Matter contain—													
II. Hay and Dry Coarse Fodder — Concluded.																		
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	–	–	93.94	–	–	9.71	–	–	1.28	–	–	53.18	–	–	28.88	6.95	–
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	1	–	–	93.98	–	–	14.63	–	–	2.62	–	–	43.88	–	–	29.97	8.90	1:5.63
Alsike clover (*Trifolium hybridum* L.),	5	93.92	86.48	90.07	17.55	14.77	16.22	3.26	1.88	2.66	46.64	38.03	43.27	32.34	21.44	26.18	11.67	1:3.37
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.30	34.39	25.42	29.72	8.11	1:4.09
Sand lucerne, in bloom (*M. media* Pers.),	1	–	–	91.20	–	–	16.26	–	–	2.59	–	–	50.31	–	–	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	1	–	–	93.84	–	–	11.81	–	–	1.85	–	–	51.36	–	–	28.08	6.90	–
Blue melilot (*Melilotus cærulea* Desr.),	1	–	–	91.78	–	–	13.81	–	–	1.67	–	–	43.22	–	–	27.17	14.87	–
Sulla (*Hedysarum coronarium*),	1	–	–	89.54	–	–	17.03	–	–	3.16	–	–	58.66	–	–	12.38	8.77	–
Hairy lotus (*Lotus villosus* Thuill.),	2	89.32	87.64	88.48	16.12	13.49	14.81	3.00	2.69	2.85	57.82	50.80	54.29	24.49	15.07	19.78	8.27	–
Soja bean,	2	93.88	93.52	93.70	15.87	15.10	15.49	6.35	5.62	5.99	51.28	48.25	49.75	21.75	20.76	21.26	7.51	1:4.52
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.93	23.58	19.06	21.67	9.29	1:4.82
Serradella,	3	92.80	87.23	90.44	17.97	15.26	17.03	2.91	2.37	2.55	50.23	44.49	48.18	25.92	24.37	25.15	7.00	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	–	–	92.56	–	–	19.58	–	–	1.22	–	–	38.95	–	–	31.88	8.37	–
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.20	43.80	30.68	30.05	30.37	8.24	1:3.87
Vetch and oats,	1	–	–	87.47	–	–	7.72	–	–	2.53	–	–	49.00	–	–	36.22	4.53	1:11.26

Horse-bean straw,	1	–	–	90.85	–	–	9.69	–	–	1.51	–	–	37.77	–	–	41.44	9.59	1:8.55
White daisy (*Chrysanthemum Leucanthemum* L.),	1	–	–	90.35	–	–	7.68	–	–	2.32	–	–	46.86	–	–	36.09	7.05	–
Dry carrot tops,	1	–	–	90.24	–	–	20.12	–	–	2.01	–	–	50.39	–	–	13.61	13.87	–
Wheat straw,	1	–	–	93.80	–	–	7.20	–	–	1.63	–	–	50.46	–	–	35.91	4.80	1:8.00
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58	1:8.24
Beets, sugar,	9	19.53	13.05	15.62	17.44	7.32	10.84	.83	.58	.65	81.50	72.79	77.87	6.98	4.82	6.00	4.64	1:12.15
Beets, yellow fodder,	1	–	–	9.40	–	–	12.78	–	–	1.80	–	–	67.50	–	–	7.83	10.09	1:8.33
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.75	9.54	7.08	7.94	9.06	1:9.94
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	3	12.52	9.95	10.82	9.63	7.98	8.84	3.94	1.67	2.50	73.96	67.24	70.99	10.76	7.55	9.53	8.14	1:9.81
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	28	91.98	65.50	89.55	15.02	8.49	12.24	9.43	4.25	5.47	83.98	71.06	78.44	3.38	1.03	2.14	1.71	1:8.16
Corn kernels and cobs (corn and cob meal),	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.62	9.77	5.39	7.34	1.67	1:8.63
Wheat grain,	1	–	–	89.42	–	–	13.35	–	–	1.79	–	–	80.26	–	–	2.42	2.18	1:6.42
Broom-corn seed,	1	–	–	85.90	–	–	11.21	–	–	4.05	–	–	74.05	–	–	8.34	2.35	–
Soja beans (*Soja hispida* Mönch.),	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans (*Vicia faba* L.),	1	–	–	89.72	–	–	30.03	–	–	1.11	–	–	56.48	–	–	8.11	4.27	1:2.24

A. Analyses of Fodder Articles — Concluded.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													Nutritive Ratio (Average).
					Protein.			Fat.			Nitrogen—Free Extract.			Fibre.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver	Max.	Min.	Aver.		
V. Flour and Meal.																		
Corn meal,	18	89.95	82.96	**87.24**	16.08	10.19	**11.26**	5.08	3.10	**4.35**	83.24	73.20	**80.34**	3.60	1.20	**2.42**	1.63	1:8.94
Hominy meal,	3	91.89	89.30	**90.75**	11.83	11.20	**11.61**	12.22	4.89	**9.33**	78.07	68.00	**72.55**	4.78	3.69	**4.08**	2.43	1:8.82
Ground barley,	2	87.81	86.39	**87.10**	11.17	10.42	**10.80**	2.19	1.69	**1.94**	78.25	77.45	**77.79**	7.37	6.85	**7.11**	2.36	1:9.72
Broom-corn meal,	1	–	–	**86.46**	–	–	**11.14**	–	–	**4.13**	–	–	**74.30**	–	–	**8.00**	2.43	–
Pea meal,	1	–	–	**91.15**	–	–	**20.95**	–	–	**1.67**	–	–	**55.02**	–	–	**19.42**	2.94	–
VI. By-products and Refuse.																		
Linseed cake, old process,	4	92.52	89.54	**90.82**	38.67	30.98	**36.26**	7.98	5.69	**6.83**	44.72	37.76	**41.02**	9.69	8.04	**8.73**	7.16	1:1.67
Linseed cake, new process,	2	93.99	91.42	**92.71**	40.76	32.50	**36.63**	3.18	3.14	**3.16**	46.49	40.83	**42.66**	10.31	9.23	**9.77**	6.78	1:1.45
Cotton-seed meal,	7	93.16	90.11	**91.92**	47.04	18.17	**42.22**	14.72	5.22	**13.48**	54.55	25.03	**28.02**	14.80	6.28	**8.22**	8.06	1:1.45
Wheat bran,	20	91.90	86.30	**89.30**	20.24	15.67	**17.56**	6.08	2.80	**4.83**	62.18	50.89	**59.87**	14.26	7.49	**10.83**	6.91	1:3.85
Wheat middlings,	3	90.75	89.45	**90.45**	19.21	17.23	**18.21**	6.16	3.19	**4.63**	74.30	61.62	**69.60**	8.40	1.40	**4.11**	3.45	1:4.10
Wheat shorts,	2	91.13	89.67	**90.40**	17.28	16.71	**17.00**	5.86	5.52	**5.69**	61.71	58.03	**59.86**	11.21	8.58	**9.90**	7.55	1:4.09
Rye bran,	2	91.82	86.30	**89.06**	18.98	16.52	**17.75**	3.03	2.07	**2.55**	73.56	69.24	**71.70**	4.54	3.46	**4.00**	4.30	1:4 88
Rye middlings,	1	–	–	**87.46**	–	–	**13.15**	–	–	**5.61**	–	–	**73.52**	–	–	**3.70**	4.02	1:7.28
Gluten meal,	17	92.15	88.32	**90.36**	39.28	28.24	**31.58**	9.34	3.92	**6.59**	66.26	48.84	**60.19**	4.74	.41	**1.12**	.59	1:2.39
Refuse from starch works,	1	–	–	**42.96**	–	–	**22.41**	–	–	**10.17**	–	–	**58.98**	–	–	**7.54**	.90	–

Spent brewer's grain,	1	–	–	93.02	–	–	20.49	–	–	1.95	–	–	55.51	–	–	15.90	6.15	1:3.06
Cocoa dust, from cocoa manufactory,	1	–	–	92.90	–	–	15.47	–	–	25.85	–	–	45.99	–	–	5.86	6.83	–
Broom-corn waste,	1	–	–	91.30	–	–	6.78	–	–	1.00	–	–	48.09	–	–	39.25	4.88	–
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	–
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.2	72.56	16.58	13.15	14.86	1.46	–
Apple-pomace ensilage,	1	–	–	14.67	–	–	8.22	–	–	7.36	–	–	58.03	–	–	22.18	4.21	–
Sugar-beet pulp, from diffusion battery,	1	–	–	10.32	–	–	12.41	–	–	.95	–	–	61.86	–	–	23.74	1.04	–
Corn cobs,	4	–	–	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Palmetto root,	1	–	–	88.49	–	–	3.82	–	–	.53	–	–	69.95	–	–	21.26	4.44	–

B. Analyses of Fodder Articles, with Reference to Fertilizing Ingredients.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
I. Green Fodders.												
Corn fodder,	4	72.64	.564	1.64	.620	.102	.312	.132	.042	.281	.703	$2 78
Corn fodder, ensilage,	1	71.60	.360	1.32	.330	.050	.100	.090	.020	.140	.040	1 68
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	2 09
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 65
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 38
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	2 14
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 58
Horse bean,	1	74.71	.675	1.45	1.370	.090	1.370	.620	.200	.330	2.040	3 87
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 51
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 92
White lupine,	1	85.35	.440	.74	1.730	.080	3.070	.730	.170	.350	.900	3 39
Spanish moss (*Tillandsia*),	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 20
II. Hay and Dry Coarse Fodders.												
English hay (mixed hays),	3	11.26	1.370	6.34	1.541	.077	.401	.197	.045	.352	.890	6 38
Rowen,	2	12.48	1.746	9.57	1.966	.168	.814	.250	.064	.464	1.920	8 16

Timothy hay,	2	7.52	1.260	4.93	1.530	.220	.710	.100	–	.460	1.170	6 14
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.362	1.736	5 20
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 55
Meadow fescue,	4	9.79	.942	7.88	2.005	.225	.566	.160	.030	.343	1.883	5 31
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	6 16
Italian rye grass,	2	8.29	1.150	6.89	.992	.595	1.072	.306	.098	.552	2.899	5 41
Salt hay,	1	5.36	1.180	–	.718	.017	.371	.335	.028	.248	–	4 92
Corn fodder,	4	–	1.800	4.91	.760	.010	.600	.690	.070	.510	1.650	7 38
Corn stover,	2	28.24	1.118	3.74	1.320	.794	.524	.257	.056	.303	.811	5 28
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 72
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	9 38
Medium red clover,	1	10.72	2.089	8.36	2.201	.192	1.838	.402	.061	.436	.254	9 49
Alsike clover,	5	9.93	2.331	11.11	2.008	.317	2.209	.537	.216	.703	1.746	10 46
Lucerne (*alfalfa*),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 92
Bokhara clover,	1	6.36	1.770	6.46	1.673	.077	1.938	.373	.025	.436	.013	7 96
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	9 55
Sulla,	1	10.46	2.441	7.85	1.872	.362	2.791	.378	.147	.424	.987	10 40
Lotus villosus,	1	12.36	2.259	7.32	1.550	.633	2.861	.615	.148	.500	1.053	9 50
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	9 54
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	6 96
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	10 64
Vetch and oats,	2	11.98	1.368	10.96	.903	.199	.539	.253	.137	.525	.212	6 05

B. Analyses of Fodder Articles, with Reference to Fertilizing Ingredients — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
II. Hay and Dry Coarse Fodders — Concluded.												
White daisy,	1	9.65	.279	6.37	1.253	.164	1.302	.191	.032	.435	1.110	$2 54
Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	15 52
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	.243	1.13	.436	.091	.049	.033	.004	.091	.020	1 31
Beets, sugar,	2	84.65	.250	.80	.285	.151	.056	.037	.018	.083	.066	1 19
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	1 14
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 06
Ruta-bagas,	2	87.82	.210	1.10	.500	.100	.090	.030	.003	.131	.010	1 30
Turnips,	1	87.20	.221	1.01	.412	.133	.117	.033	.009	.116	.072	1 22
Carrots,	1	90.02	.140	.88	.540	.110	070	.020	.010	.100	.010	1 06
Potatoes,	1	79.75	.207	.99	.294	.013	007	.020	.002	.066	.006	1 03
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	49
IV. Grains and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	6 37
Corn kernels and cobs (cob meal),	4	10.00	1.460	1.45	.441	.121	.057	.162	.004	.603	.091	6 05
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	21 96

V. Flour and Meal.												
Corn meal,	2	13.52	**2.05**	1.42	**.435**	.064	.034	.187	.015	**.707**	.005	7 85
Hominy feed,	1	8.93	**1.63**	2.21	**.490**	–	.180	.280	–	**.980**	–	6 14
Ground barley,	1	13.43	**1.55**	2.06	**.341**	.169	.091	.173	.013	**.660**	.669	6 25
Wheat flour,	1	9.83	**2.21**	1.22	**.540**	–	.170	.050	–	**.570**	–	8 65
Pea meal,	1	8.85	**3.08**	2.68	**.993**	.618	.302	.302	.027	**.820**	.122	11 31
VI. By-products and Refuse.												
Linseed cake, old process,	3	7.79	**6.021**	7.13	**1.162**	–	.656	.799	.060	**1.646**	.355	23 44
Linseed cake, new process,	2	6.12	**5.396**	5.33	**1.160**	–	.552	.534	.047	**1.420**	.152	21 02
Cotton-seed meal,	6	8.36	**6.41**	6.27	**1.620**	.190	.710	1.100	.190	**2.090**	.501	25 68
Wheat bran,	4	11.01	**2.88**	6.44	**1.620**	.180	.200	.900	.020	**2.870**	.130	14 77
Wheat middlings,	1	9.18	**2.63**	2.30	**.630**	.110	.200	.210	–	**.950**	–	10 63
Rye middlings,	1	12.54	**1.84**	3.52	**.810**	.030	.090	.320	.020	**1.260**	.170	8 46
Gluten meal,	4	8.53	**5.43**	.65	**.045**	.018	.050	.035	.069	**.425**	–	19 01
Spent brewer's grain,	1	6.98	**3.05**	6.15	**1.550**	.347	.296	.286	.159	**1.260**	1.770	12 14
Cocoa dust,	1	7.10	**2.299**	6.35	**.630**	–	.630	–	–	**1.340**	–	11 22
Broom-corn waste (stalks),	1	10.37	**.870**	4.70	**1.858**	–	.242	.170	–	**.460**	1.000	5 09
Cotton hulls,	3	10.63	**.750**	2.61	**1.080**	–	.200	.260	–	**.180**	.060	3 74
Apple pomace,	2	80.50	**.227**	.271	**.134**	.026	.037	.028	.008	**.018**	.009	90
Corn cobs,	8	12.09	**.504**	.815	**.598**	.071	.025	.045	.009	**.063**	.190	2 44
Palmetto root,	1	11.51	**.540**	3.93	**1.380**	.345	.045	.004	.017	**.157**	.410	3 20

NOTE.—Basis of valuation, nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4¼ cents per pound.

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	*Soda sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin),	Sept. 1,	20.14	1.055	12—15	3.09	-	-	-
Apple (Baldwin),	Oct. 9,	19.66	1.065	12—15	6.25	-	-	-
Apple (Baldwin),	Nov. 27,	-	1.075	12—15	10.42	-	-	-
Rhode Island Greening,	Sept. 1,	20.27	1.055	12—15	3.16	-	-	-
Rhode Island Greening,	Oct. 9,	19.68	1.066	12—15	7.14	-	-	-
Rhode Island Greening,†	Nov. 27,	20.25	1.080	12—15	11.36	-	-	-
Pear (Bartlett),	Aug. 31,	15.00	1.060	12—15	4.77	-	-	-
Pear (Bartlett),	Sept. 7,	16.55	1.060	12—15	5.68	-	-	-
Pear (Bartlett),	Sept. 20,	-	1.065	12—15	8.62	-	-	-
Pear (Bartlett),‡	Sept. 22,	-	1.060	12—15	8.93	-	-	-
Cranberries,	-	10.71	1.025	15	1.35	-	-	-§
Cranberries,	1878.	10.11	1.025	15	1.70	-	-	-‖
Early York Peach (ripe),	-	-	1.045	25	-	1.92	6.09	45
Early York Peach (nearly ripe),	-	10.96¶	1.039	25	-	1.36	4.12	42.3
Crawford Peach (nearly ripe),	-	-	1.050	18	-	2.19	7.02	85.6
Crawford Peach (mellow),	-	11.36¶	1.055	18	-	1.70	8.94	76
Crawford Peach (not mellow),	-	11.88¶	1.045	22	-	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C. C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	-
Concord,	July 20,	1.0150	31	8.10	.625	7.72	216
Concord,	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord,	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord,	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord,	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord,	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape,	July 19,	1.020	31	9.00	.714	7.93	204
Purple Wild Grape,	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Purple Wild Grape,	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Purple Wild Grape,	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seeding,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord,	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure $Na_2 CO_3$ in 100 parts water.

C. *Analyses of Fruits* — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	*Soda Solution required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled,	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled,	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained — Ash.	Moisture.	Grape Sugar.	Soda Solution required for 100 parts of Grapes.
	1889.				
Concord, not girdled,	Sept. 23,	–	84.69	6.24	75
Concord, girdled,	Sept. 23,	.42	83.00	8.13	85.4
Concord, not girdled,	Oct. 8,	.53	84.51	6.09	48
Concord, girdled,	Oct. 8,	.37	82.69	8.50	50

* One part $Na_2\ CO_3$ to 100 parts of water.

C. *Analyses of Fruits* — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Grape Sugar.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	–	–	13.51	–	Fertilized.
Wild Purple Grape Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
Wild Purple Grape Juice, . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	–	–	–	–	Unfertilized.
Wild White Grape Berries, .	"	21.65	–	–	–	–	Fertilized.
Wild White Grape Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, . .	"	–	–	–	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. *Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 Parts of Ash contained —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches, *	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine, †	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Clinton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit), ‡	.52	49.24	3.23	13.47	8,12	1.74	18.50	5.66
Strawberry (fruit), §	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased, ‖	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased, ‖	–	15.67	–	64.23	10.28	1.45	8.37	–
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	Saxony, .	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. White Imperial, ...	Saxony, .	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	Saxony, .	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, ...	Saxony, .	$1\frac{1}{2}$ to 2	13.10
II. White Magdeburg, ...	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard-manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	Fresh yard-manure, .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard-manure and chemicals, . . .	12.75	9.17	3.58	71.92
Warm alluvial, .	Fresh hog-manure, .	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard-manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, ...	12.55	13.24	10.50
Kainite and superphosphate, . .	13 15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable-manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

LOCALITY OF BEET-FIELD.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y., . . .	1872–73	11	7.80	3.20
2. Washington, N. Y., . . .	"	14	10.97	3.03
3. South Hartford, N. Y., . .	"	15	11.70	3.30
4. Greenwich, N. Y., . . .	"	12	9.50	2.50
5. Frankfort, N. Y., . . .	"	13.5	11.00	2 50
6. Albion, N. Y.,* . . .	"	18	15.10	2.90
Albion, N. Y.,† . . .	"	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 14 lbs.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

WHERE GROWN.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal, . .	2 to 2½ lbs.	15.4°	64° F.	11.38
Reviere du Loup, . . .	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly, ...	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge, ...	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15, .	No flower stalks in sight,* . .	4.2	27	2.48	None	6.8	7.93
Aug. 16, .	No flower stalks in sight,* . .	5.8	24	4.06	None	9.6	11.10
Aug. 20, .	Flower stalks developed,* . .	7.9	24	3.47	2.15	7.0	13.00
Aug. 24, .	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27, .	Plants in full bloom,* . . .	10.0	25	3.65	4.13	10.0	15.48
Aug. 30, .	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2, .	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9, .	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9, .	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18, .	Left on field without stripping,* .	13.2	22	3.57	7.65	–	–
Sept. 18, .	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18, .	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18, .	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21, .	Juice from the above,* . . .	13.0	21	–	–	–	–
Sept. 23, .	Juice from the above,* . . .	15.0	18	–	–	–	–
Sept. 25, .	Left on field 3 weeks,† . . .	19.8	21	11.91	6.27	–	–
Sept. 28, .	Left on field 3 weeks,† . . .	17.8	12	16.60	–	–	–
Oct. 4, .	Left on field 3 weeks,† . . .	16.1	17	8.62	6.16	12.0	–
Oct. 7, .	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8, .	Freshly cut. Stripped 2 weeks,† .	12.8	17	5.16	5.27	7.0	–
Oct. 9, .	Freshly cut. Stripped 2 weeks,† .	18.4	17	7.57	–	10.6	–
Oct. 14, .	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18, .	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19, .	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22, .	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23, .	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24, .	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 PARTS OF CANE CONTAINED —				
		Moisture.	Grape Sugar.	Cane Sugar.	Total Sugar.	
1879.						
October, .	Early Tennessee sorghum, mature, .	77.43	1.79	3.21	5.00	Grown on station grounds.
October, .	Price's new hybrid, ripe, . . .	77.80	2.92	3.78	6.70	
October, .	Kansas orange, green, . . .	80.67	2.38	3.63	6.01	
October, .	New orange, green, ...	78.30	2.96	3.85	6.81	
October, .	Honduras, green, ...	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4.85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
Red-flesh water-melon,	1.025	19	3.84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
Nutmeg musk-melon, ¶	1.050	20	2.27	5.38	–
Nutmeg musk-melon, **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

	Analyses.	Solids.			Fat.			Curd.			Salt.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	50	16.70	11.96	13.60	5.45	2.48	3.95	–	–	3.20	–	–	–	.70
Skim-milk,	–	–	–	10.19	–	–	.37	–	–	3.53	–	–	–	.80
Buttermilk,	–	–	–	8.16	–	–	.21	–	–	2.79	–	–	–	.80
Cream,	54	28.51	22.65	25.03	20.90	13.74	16.99	–	–	–	–	–	–	.62
Butter,	24	92.89	87.05	89.17	89.05	81.43	83.98	.89	.51	.66	6.45	3.61	4.80	–
Whole-milk cheese (Jersey),*	1	–	–	62.84	–	–	37.32	–	–	22.13	–	–	–	3.39
Whole-milk cheese,*	1	–	–	64.17	–	–	34.34	–	–	26.69	–	–	–	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	–	–	62.70	–	–	27.81	–	–	30.37	–	–	–	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	–	–	57.76	–	–	23.42	–	–	31.99	–	–	–	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	–	–	56.05	–		17.67	–	–	33.24	–	–	–	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	–	–	54.59	–	–	15.77	–	–	34.94	–	–	–	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	–	–	51.62	–	.	18.35	–	–	28.63	–	–	–	4.64
Genuine oleomargarine cheese,*	1	–	–	62.10	–	–	31.66	–	–	25.94	–	–	–	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	–	–	–	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	3.16	.356	.140	–	–	–	
Solar salt from Kansas,	4.950	93.060	1.220	–	.240	.350	.180	–	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	–	.080	.390	None.	–	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	–	–	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	–	–	.072	
Ashton salt (sent on),	.760	97.650	1.430	–	.060	–	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	–	–	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98 202	.877	.168	.046	–	–	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	–	–	.700	

METEOROLOGY.

1889.

Our weather observations have been conducted on the same general plan as in previous years, being essentially the same as that recommended to voluntary observers of the United States Signal Service. Besides this, we have during the summer months forwarded to a signal officer at Cambridge, Mass., a weekly report of temperature, rainfall and sunshine, and their effects as observed on the growth of crops in this vicinity. This report was for use of the New England Meteorological Society and the United States Signal Service in preparing a weekly weather and crop bulletin.

The winter months of 1889 were exceptionally mild. Our lowest temperature during that time was nine degrees below zero. Ice did not form thick enough to be cut until the first part of February. There was no snow on the ground until the 20th of January. Sleighs were in use from that date until the last week in February; most of the time, however, hardly enough snow for good sleighing. A snow-storm, amounting to 4.5 inches, occurred on March 31 and April 1. This snow quickly disappeared.

On account of the warm and dry weather during the spring, the ground was prepared and planted somewhat earlier than usual. Heavy frosts occurred May 4 and 29: the latter touched our more tender crops, but apparently did not affect corn or potatoes.

February, March and April were our driest months; less than three inches of water fell during February and March. The rains of May were abundant and well distributed. During June, July and the first part of August, an unusual number of rainy days interfered seriously with farm work; considerable damage was done in our vicinity to partially cured hay and grain.

The average temperature of July and August was lower than usual. The cool weather during those two months retarded the ripening of corn, and was evidently injurious to most crops, judging from the unusual prevalence of fungous diseases.

The first frost occurred September 23; the first snow-fall occurred November 27, and the first snow-storm, December 5, amounting, in the latter case, to an inch and a half of snow. The severest snow-storm, amounting to 6.5 inches of snow, occurred December 14. Both of these snows disappeared soon.

During eight months of the year the prevailing wind was north-west; during March, September and October, the prevailing direction was north-east; and during June, south-west.

The rainfall during the year amounted to 43.72 inches, which is slightly below the average. The number of days on which an appreciable quantity of water fell was 128. The largest number occurring in one month was 15, in July; the smallest, 7, in August. The largest rainfall for one month was 8.35 inches, in July; the smallest, 1.45 inches, in February.

During the first seven months of the year there were fifty-four days during which the sky was more than seven-tenths overcast by clouds at each observation. During the last five months, when a more detailed system of taking the observation was used, sixty-six days were noticed "cloudy;" twenty cloudy days occurred in September. On twenty-three days during the first seven months, the sky was found less than four-tenths overcast at each observation. April and June had each but one "clear" day; during the last five months there were but twenty-four clear days.

The mean annual temperature was 47.78 degrees, which is nearly 1 degree above the average. The highest temperature for the year was 89 5 degrees, occurring May 9; the lowest, — 9 degrees, occurring February 24. The maximum for 1888 was 94.5 degrees, on July 23; the minimum, — 21.5 degrees, January 23. The absolute range of temperature for 1889 was 98.5 degrees, against 116 for 1888, 115.2 for 1887, and 117 for 1886.

Summary of Meteorological Observations, 1889.

	Temperature, Degrees Fahrenheit.											Relative Humidity, Per Ct.				Precipitation, Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . . .	25.5	35.2	30.2	30.3	49.1	16.1	33.0	58.0	9th	0.5	23d	–	–	–	–	3.29	9th
February, . . .	15.6	25.8	20.8	20.8	37.9	1.9	36.0	42.0	17th	—9.0	24th	–	–	–	–	1.45	18th
March, . . .	30.7	42.5	35.3	35.9	49.9	27.6	22.3	63.5	24th	14 0	1st	–	–	–	–	1.46	31st
April, . . .	42.0	56.4	45.4	47.4	63.9	32.9	31.0	78.0	19th	25.0	23d	80.7	49.1	71.7	67.2	2.42	1st
May, . . .	53.4	69.2	58.0	59.8	72.6	45.5	27.1	89.5	9th	31.0	4th	83.9	53.6	75.9	71.1	4.15	27th
June, . . .	61.6	73.9	64.9	66.4	76.4	53.6	22.8	88.5	30th	38.0	7th	89.2	61.0	84.0	78.0	3.85	11th
July, . . .	65.0	75.0	66.2	68.1	74.1	58.5	15.6	86.0	8th	46.5	16th	89.2	66.9	85.7	80.6	8.35	29th–31st
August, . . .	58.7	74.0	62.5	64.4	74.7	58.1	16.6	84.0	31st	40.5	29th	94.4	61.2	88.0	81.2	2.69	14th
September, . .	56.3	67.9	59.7	60.9	72.6	46.1	26.5	82.5	6th	34.5	23d	92.0	67.6	84.7	81.4	2.90	17th–19th
October, . .	39.8	53.2	44.0	45.2	60.8	32.7	28.1	69 5	1st	21.0	24th	–	–	–	–	4.10	27th
November, . .	37.0	45.8	39.8	40.6	51.1	24.1	27.0	62.5	3d	14.5	17th	–	–	–	–	6.21	27th–28th
December, . .	29.6	38.9	32.8	33.5	48.9	11.1	37.8	64.0	25th	3.5	4th	–	–	–	–	2.85	8th–9th
Sums, . .	515.2	657.8	559.6	573.3	732.0	408.2	323.8	868.0	–	260.0	–	529.4	359.4	490.0	459.5	43.72	–
Means, . . .	42.94	54.82	46.63	47.78	61.00	34 02	20.98	72.33	–	21.67	–	88.23	59.90	81.67	76.58	3.64	–

Miscellaneous Phenomena, — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Solar Halos.	Lunar Halos.
January, .	4, 5, 13, 15, 26,	20, 21, 27, 28,	5, 6, 7, 9, 16, 17,	–	–	15.
February, .	11,	6, 8, 9, 11, 12, 18, 27.	5, 16, 17,	–	–	–
March, .	1, 13, 15,	31,	4, 5, 6, 16, 17, 28, 29.	28,	–	–
April, . .	7, 10, 11, 15, 23,	1,	1, 3, 20, 25, 26, 27, 28.	20,	–	11, 15, 16.
May, . .	4, 29,	–	10, 11, 13, 14, 20, 21, 25, 26, 27, 30, 31.	10, 14, 25,	–	–
June, . .	7,	–	1, 2, 4, 6, 8, 10, 11, 12, 15, 17, 22, 26.	10, 11, 15,	3,	–
July, . .	–	–	2, 3, 4, 8, 9, 10, 11, 14, 15, 20, 27, 29, 30, 31.	7, 8, 29, 30,	–	–
August, .	–	–	1, 3, 5, 9, 13, 14, 15,	3, 14,	–	–
September, .	23,	–	11, 12, 13, 17, 18, 19, 20, 25, 26, 30.	17,	–	–
October, .	3, 5, 8, 9, 11, 12, 16, 17, 19, 22, 24.	–	1, 6, 7, 10, 12, 13, 20, 21, 22, 26, 27, 28, 29, 31.	–	–	–
November, .	4, 11, 16, 17, 18,	–	2, 3, 9, 10, 11, 13, 19, 20, 21, 22, 23, 27, 28.	–	–	1, 8.
December, .	5, 10, 22, 24, 29, 31.	5, 14,	8, 9, 10, 11, 18, 19, 22, 24, 29.	–	–	–

RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter, beginning with the year 1836.

December, January, February.	Degrees F.	June, July, August.	Degrees F.
1836–37,	25.396	1837,	69.130
1837–38,	26.386	1838,	69.550
1838–39,	25.950	1839,	70.180
1839–40,	20.626	1840,	68.770
1840–41,	23.146	1841,	69.230
1841–42,	28.516	1842,	68.210
1842–43,	23.460	1843,	67.950
1843–44,	21,320	1844,	67.260
1844–45,	25.550	1845,	70.120
1845–46,	22.140	1846,	68.406
1846–47,	25.176	1847,	68.806
1847–48,	28.966	1848,	69.210
1848–49,	23.026	1849,	69.210
1849–50,	27.570	1850,	68.820
1850–51,	25.040	1851,	66.640
1851–52,	21.620	1852,	66 830
1852–53,	27.940	1853,	67.846
1853–54,	23.670	1854,	69.856
1854–55,	23.126	1855,	67.146
1855–56,	20.820	1856,	69.225
1856–57,	22.720	1857,	67.240
1857–58,	26.956	1858,	67.930
1858–59,	24.746	1859,	65.650
1859–60,	24.790	1860,	66.540
1860–61,	24 510	1861,	66.870
1861–62,	24.470	1862,	66.490
1862–63,	27.640	1863,	66.656
1863–64,	26.060	1864,	69.336
1864–65,	21.310	1865,	68.946
1865–66,	25.676	1866,	67.400
1866–67,	25 276	1867,	67.920

Record of Temperature, etc. — Concluded.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30 506	1880, . . .	69.286
1880–81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882–83, . .	24.220	1833, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886–87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893
1888–89, . .	27.170	1889, . . .	66.300

C. A. GOESSMANN,
Director.

JAMES P. LYNDE, *Treasurer, in account with* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1889.	RECEIVED.		1889.	EXPENDED.	
	From State Treasurer,	$10,000 00		Transferred to Hatch funds,	$705 33
	Dr. C. A. Goessmann, director, receipts at station,	991 75		Salaries,	5,057 52
	Dr. C. A. Goessmann, director, fees for certificates of analysis of commercial fertilizers,	1,530 00		Laboratory supplies,	927 48
				Printing and postage,	509 40
				Office expenses,	126 53
				Farmer and labor,	2,600 92
				Farm supplies,	610 72
				Stock,	363 52
				Feed,	354 02
				Miscellaneous expenses,	598 37
				Construction and repairs,	464 64
				Expenses Board of Control,	188 30
				Cash in bank,	15 00
		$12,521 75			$12,521 75

Examined, compared with the vouchers, found correct and approved. WM. R. SESSIONS, *Auditor.*

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